CONSUMPTION IN MADRAS

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CONSUMPTION IN MADRAS.

While meagre Phthisis gives a silent blow,
Her strokes are sure, but her advances slow,
No loud alarms nor fierce assaults are shown ;
She starves the fortress first, then takes the town.

(Garth.)

Tuberculosis is a disease caused by the destructive lesions set up in the lungs or in other parts of the body by the microbe—Bacillus tuberculosis—a minute rod like organism 1/80,000th of an inch in diameter and 1/6,000th to 1/16,000th of an inch in length.

When introduced into the body, this microbe multiplies in the tissues to an enormous extent. The poison produced by these microbes in the body leads to the formation of tiny inflammatory growths called tubercles, which may be of the size of a large pin's head. The tubercles produced may be so numerous as to occupy large portions of the lungs or other organs. As tubercles have a tendency to disintegrate, soften and break down, the lungs attacked by the tubercles become riddled with holes and cavities, as the disease progresses.

Tuberculosis may be so slight as not even to be detected or so severe as to cause death within a few weeks. Tuberculosis may be found in any part of body—lungs, pleuræ, peritoneum, intestines, kidneys, bladder, liver, spleen, brain, coverings of the brain, glands, bones, joints, skin, eye, genitalia, etc.

Tuberculosis is a very common disease and is distributed over the whole of the civilised world. It is a disease of all times and of all countries. Pulmonary tuberculosis, or consumption, the most common form of tuberculosis has existed from very remote times. It was a disease familiar to the Babylonian and the Egyptian physicians. References to this disease are to be found in the Old Testament of the Bible (B. C. 1500). It is believed that it was this disease which Moses pronounced as a curse for disobedience. References are also said to be met with in the Talmud (B. C. 500). Distinct reference is made to this disease which is known as Raja Yakshma in the Hindu Vedas revealed about 3000 B. C. The God of the Moon is stated to have suffered from this complaint as the result of a curse for disobedience to his father-in-law and excessive attachment to his wife Rohini. Kalidasa (6th century A.D.) relates in the last chapter of his Raghuvamsa that Agnimitra, the last of the line of Raghus, suffered from consumption and died of it. It is stated that the disease was due to excessive venery and that it was a fatal disease that baffled all the efforts of skilful physicians. Charaka (1st century A.D.) states in his book on medicine that the God of the Moon contracted the disease on account of his indifference to his health and sexual excess, and became gradually emaciated on account of the loss of fat in his body. The physicians to the Gods, Asvinikumaras cured him of his complaint which was driven away to this human world. Haritha speaks of it as a terrible disease of men brought on by over-exertion, insufficient food, insufficient sleep and sexual excess. Vaghbhatta, (11th century A.D.) the author of Ashtangahridaya, calls it the King of diseases which is accompanied by many complications. He describes nasal catarrh, chronic loss of appetite, emaciation, nausea, vomiting, debility, anœmia, and dropsy of the feet amongst the premonitory symptoms.

Dyspnœa, cough, chronic cold, pain in the chest and the throat, loss of appetite, constipation, fever, pain in the joints, frequent yawning, foulness of the mouth, difficulty in swallowing, hoarseness or loss of voice, diarrhœa, spitting of phlegm, spitting of blood, heaviness of the body and the head, are all described as symptoms of this disease. Further he advises physicians who care for their reputation not to treat the patients in whom the physical signs are slight in proportion to the constitutional symptoms. I may state here that my experience is confirmatory of these views. Susruta (4th century A.D.) calls it the "Big disease" with many complications and many premonitory symptoms, which is difficult to diagnose, and difficult to treat. He notes loss of appetite, fever, dyspnœa, cough, hœmoptysis, alteration of the voice, pain, drooping of the shoulders, refraction of the chest, fever, burning sensation in the body, diarrhœa, and heaviness in the head amongst the symptoms of this disease. Susruta as well as Madhava advise physicians, to avoid the cases with cough, anorexia, fever, diarrhœa, pain in the sides, and alteration of the voice; and the cases with hœmoptysis, fever, and cough. Both these physicians were aware of the bad prognosis in intestinal and laryngeal tuberculosis and had a justifiable dread of the cases with frequent hœmoptysis. It is also stated by them that the best cases to be treated are those with a good appetite, slight emaciation and little or no fever—exactly the cases selected for sanatorium treatment at the present day. Thus they are entirely in accord with the phthisiotherapists of the present day in the selection of the cases for treatment. Whether for the sanatorium treatment, or for the tuberculin treatment, we prefer now-a-days to select febrile cases and those with a fair amount of appetite. The Sanskrit physicians began the treatment of the disease with emetics and purgatives and subsequently made use of stomachics and tonics, and easily digestible palatable food. They attached great importance to milk, ghee and flesh (particularly of the goat) as articles of diet. They further recommended that the meat should be administered to the patient without his knowledge for fear of producing disgust, nausea and vomiting, which can be ill borne by the consumptives. Meat is recommended in the form of curry, soup, or fried meat. Admixture with a fair amount of fat is insisted upon. At the present day the articles of diet which have been found most useful for the consumptives are meat, milk, eggs and various forms of fat. Some of the European physicians in modern times recommend the flesh of horses and goats, as these animals have been found to be refractory to tuberculosis (probably due to the presence of some antibodies in their system).

The Sanskrit writers do not recommend any change of climate for this disease although they recommend particular climates for other diseases.

Hippocrates (460-376 B. C.) is believed to have been the first in Europe to give an intelligent description of Phthisis. The Hippocratic school believed in the cure of Phthisis (in all stages) and the benefits resulting from a change of residence. The contagiousness of the disease is stated to have been pointed out by Isocrates and Aristotle. Aretæus (50 A. D.) believed in the efficacy of sea voyages and country air. Pliny lauded pine forests for their healing powers, and Galen seems to have believed in the treatment in high altitudes.

At the end of the 17th century Sylvius made a scientific study of the pathology of the disease, gave a careful description of the symptoms, and believed in the contagiousness of the disease. In 1819 Lænnec made very important additions to our clinical knowledge of the disease. In 1865, Villemin after an elaborate experimental study came to the conclusion that tuberculosis was a specific affection, that it had its origin in an inoculable agent and that it should be classed with specific diseases like small-pox and syphilis. In 1882 Robert Koch, by his classical experiments, firmly established the true pathology of the disease. Koch's demonstration of the causative relation of the tubercle bacillus to tuberculosis was so complete that but little of importance has since been added. The investigations of Cornet in 1888 on the presence of the tubercle bacilli in the dust, have been of very great value in directing our attention to the infectiousness of the sputum, and to the necessary prophylactic measures in the prevention of the spread of this disease. Koch did not rest satisfied with discovering the cause of tuberculosis; he later on discovered the use of tuberculin as a diagnostic and curative agent in 1890. The value of this discovery was long belittled by medical men. Immediately after its discovery, tuberculin was rashly used in the most unsuitable cases, in direct contravention of the rules laid down by Koch as absolutely essential, and such rash use led to great disasters.

But during the past 10 years the use of tuberculin has been slowly gaining ground all over the world. At the present day its value is being recognised in the various sanatoria in Germany, America and even in France and England. Investigators of the present day are rediscovering the Laws originally laid down by Koch as essential to success, when he first made this announcement.

Tuberculosis has been stated to be not only a disease of all nations but also a very common disease amongst all civilised nations, Koch estimated that 1/7th of all the deaths in the civilised countries was due to tuberculosis ; and he held that an enormous proportion of individuals, unconsciously harboured latent foci of infection. Kayserling stated at the Paris Tuberculosis Congress that 1/3 of all the deaths and that half of the sickness amongst adults in Germany were due to tuberculosis. Newsholme is of opinion that 1/9th of all the deaths in England and Wales is due to tuberculosis. Pye Smith states that 1/3 of the deaths between 15 and 45 years of age in England is due to Phthisis. The United States Census of 1900 showed the mortality from tuberculosis to be 1/9th of all the deaths. Dr. Kidd believes that 1/13th of the total death-rate of the world is attributable to tuberculosis. There are no reliable morbidity statistics, but it is usual to multiply the number of deaths by 3 to find out the number of people suffering from this disease.

Consumptives often eject for whole months large quantities of sputum containing an enormous number of tubercle bacilli. An advanced consumptive would throw out 7,280 Millions of bacilli in a day (Nuttall). Fischer's experiments show that the tubercle bacilli may retain their virulence for 40 days in moist virulent sputum and for 6 months in sputum dry at the ordinary temperature of the air. Thus the universal prevalence of the disease may be easily understood.

Tuberculosis is a very common disease and is distributed over the whole world. No race is exempt from the ravages of consumption and no country is exempt. No single climate grants immunity from tuberculosis. It is prevalent in all latitudes and in all altitudes. It is known to occur in all regions whether dry or moist, high or low, warm or cold. The comparative infrequency at high altitudes is easily explained by the sparseness of the population.

From a review of all available information, Hirsch came to the conclusion that the mean level of temperature had no significance for the frequency or rarity of phthisis in any locality.

The mortality from pulmonary tuberculosis in Iceland is very low, whereas in North Greenland Phthisis is one of the commonest causes of death. The North Coast of Africa, Morocco, and Algiers are said to be free from consumption ; but at Tunis, Alexandria and Damietta the disease is said to be very prevalent. To secure immunity from tuberculosis it is not altogether where one lives but in what manner.

Consumption seems to follow in the wake of advancing civilization, especially where men congregate together in large numbers.

No single element in predisposition appears so important in the development of tuberculosis as poverty. The *causes* that lead to poverty are yet more important,because crowding, squalor, poor and insufficient food filth and ignorance accompany the downward trend in humanity. Dwellings which are crowded and poorly lighted and ventilated are the main sources of infection and form the chief danger to the poor in great cities.

Tuberculosis is said to be less common in the tropics than in temperate regions though more rapid in its course.

The frequency of the disease is determined more by overcrowding, poverty, occupation and neglect of the laws of health than by geographical situation. Tuberculosis has not yet drawn the attention it deserves in this country.

The disease is called the whiteman's plague in America. But it is the blackman's plague in this country.

The characteristics which make a calling appear to favour tuberculosis are as follows :—

1. A low rate of wages entailing discomfort and privations in the house.
2. Insanitary conditions of place of employment.
3. Exposure to dust arising from manufactures.
4. Excessive physical exertion or a continuous constrained position.
5. Close confinement within doors.
6. Exposure to excessive heat.
7. Temptations to intemperance.
8. Long or irregular hours.

9. Bad habits.
10. Sexual excess.
11. Irregular and insufficient sleep.

The universal distribution and the great prevalence of the disease in various parts of India, the high rate of mortality from it, the curability of the disease in the earlier stages, *if recognised early*, the easy preventability of the spread of infection in the early stages (before the conversion of the closed cases into open cases by insufficient or faulty treatment), the great infectivity of the disease in the later stages and the absolute hopelessness in the later stages of the disease—all point to the necessity for the adoption of suitable measures towards the cure, limitation and control of this disease.

For a long time medical men in this country had been unwilling to recognise the prevalence of typhoid fever and tuberculosis amongst the native population of India. But during the last 20 years medical men have been gradually convinced of the existence of both these diseases amongst the Indians. Dr. Turner, Captain Stephens, Col. Roberts, Dr. Chatterjee, Major Calvert, Major Mulvany, Dr. Row, Dr. Bose, Dr. Harris, Col. Rogers have all drawn attention in recent times to the great prevalence of tuberculosis in such widely separated places as Bombay, Darjeeling, Bengal and Central Provinces. The study of the post mortem records in the Calcutta Medical College Hospital by Col. Rogers brought out the startling fact that 25 per cent of the bodies examined post-mortem showed signs of active or latent tuberculosis. Here in Madras the disease is fairly common and is distributed over the whole Presidency. The percentage of bodies in which tubercular lesions were found post-mortem in the General Hospital, Madras, during the last 5 years is given below:—

1907	27·7 % of the bodies examined
1908	8·4
1909	11·5
1910	9·0
1911	11·2

The average for the last 5 years is 13·51 %

The returns of the Surgeon General, Madras, for cases treated for tuberculosis in the hospitals and dispensaries in this Presidency show an increase year after year. Is the increase really due to an actual increase in the prevalence of this disease or due to better diagnosis in recent times? I think it is due to both. In this country it is very difficult to obtain accurate returns for the deaths from tuberculosis. The figures available must be far below the actual number of deaths owing to inefficient registration.

At present we have to be satisfied with the returns of the Surgeon General if we want to gather any information as to the prevalence and spread of tuberculosis in this Presidency. The Surgeon General's figures refer only to the Hospital attending sick people who constitute only a minority of the population, even in localities where Hospitals are situated. And there are many places where there are no hospitals in the neighbourhood. While the people in this Presidency have not yet lost faith in the native methods of treatment in medical cases, the European methods of medical treatment have not yet won their confidence. The Hospitals are resorted to more for surgical help than for medical help. The percentage of the people resorting to the hospitals and dispensaries for medical treatment in this Presidency during the year 1910 was about 14% (or 1 in 7). The "Morbidity factor", if I may use this expression, might be taken as 7; or in other words the figures given in the Surgeon General's report for any particular disease might be multiplied by 7 to give us some rough idea of the prevalence of that disease. The figures given below and taken from the annual reports of the Surgeon General, Madras, show clearly that there has been an increase in the returns for tuberculosis during the last 10 years.

Year.	Total number of cases of tuberculosis treated.
1901	7,458
1902	6,544
1903	6,467
1904	8,543
1905	11,603
1906	8,980
1907	9,252

1908	9,949
1909	10,738
1910	13,990 or nearly 14,000.

This table brings out clearly that the number of cases of tuberculosis treated has risen 50% in 5 years and cent per cent in 10 years. A study of the annual report of 1910 brings out prominently the wide spread distribution of the disease throughout the Presidency.

If we arrange the districts in order starting with the district that had the largest number of admissions, Malabar heads the list and is followed by Madras, South Canara, Tanjore, Coimbatore, Madura, Tinnevelly, Nellore, Kurnool and Trichinopoly in the order given. The Nilgiris stands 14th in the list and has 10 districts below it, disproving the popular erroneous belief that tuberculosis is not found in elevated regions. Bellary which is very often recommended as an ideal place of residence for consumptives by medical men who have never been there, stands 16th in the list (13th in the list if the average be taken for the last 10 years) and has 8 districts below it.

The reports of the Surgeon General record 1,249 admissions, during 1910, for tuberculosis in the Hospitals and dispensaries of the city of Madras. At least an equal number of cases may be supposed to be under treatment by private practitioners outside the hospitals. Many cases of tuberculosis are being treated in Madras as malarial fever, bronchitis, influenza, &c. For some time past I have been in the habit of examining the relatives of the consumptive patients who come for treatment; and the impression left on me as the result of such examination, is that for every consumptive who applies for treatment, there are at least 2 more cases in the house in an earlier stage of the disease and not undergoing treatment. A very modest estimate of the number of people affected with tuberculosis in this city will be about 8,000. I am sure that a systematic search would reveal the presence of a far greater number of cases. If we multiply the admissions recorded in the Surgeon General's reports for Madras for 1910, namely, 1,249 by 7 which I call "the morbidity factor," we get 8,743 cases (not far from my estimate). During the year 1911 there were 700 deaths from Phthisis alone in this city. The actual figures are likely to be certainly higher, as the causes of death are not likely to be correctly entered, if the treatment before death had been in the hands of Vythians and Hakeems who thrive very largely in this city. Even in the case of patients treated by qualified men, the diagnosis of tuberculosis is often missed. Many cases of tuberculosis pass muster under "Respiratory diseases other than Phthisis," "Pyrexia of unknown origin" and "other fevers than small-pox &c." I hope medical men in this country would in future make some attempt to investigate the cases of "Pyrexia of unknown origin" and classify them under the proper headings. During the year 1910, 1,599 cases were returned as "Pyrexia of unknown origin" in the civil dispensaries of this Presidency, and 8,353 cases were returned as such in the European and Indian armies in India. The fact that 1,064 deaths (5% of all deaths) are recorded during 1911-12 in the city of Madras alone, under the heading "Pyrexia of unknown origin" should make us ask for an early investigation of the nature of this fever. In the annual report of the Sanitary Commissioner with the Government of India for 1910, the Director General has stated that this group is really made up of 5 types of disease :—

1. Probable malarial cases in which no parasites can be found.

2. One-day fever due to chills, overfatigue (I have seen 3 tubercular patients suffering from fever for 1 or 2 days as the result of overfatigue). Button-Fanning refers to a similar experience.

3. Sand-fly fever lasting for 3 days.

4. The 7-day fever of Rogers, or Dengue.

5. Serious cases of long continued fever which sometimes terminate fatally, the diagnosis being obscure throughout the course of illness.

To this list I would add, as a 6th type, cases that are really tubercular but in which the diagnosis is missed. I would not exclude tuberculosis unless Von Pirquet's test be negative.

Of all the mortality figures available I consider the figures contained in the annual report of the Oriental Insurance Company, the most reliable, as the lives are healthy to start with and as death certificates are invariably insisted upon. During 1911 out of 696 deaths among the Policy Holders, 62 deaths were reported to be due to tuberculosis. The rate of mortality, from tuberculosis (this is for the whole of India) is thus one in eleven or 9% of all deaths which is not far from the rate for England and Wales and the rate for the United States of America namely 11%.

The rate for the whole civilsed world according to Dr. Kidd is 7½ % or about 1 in 13. The fact that 9% of the deaths amongst persons who have been originally certified to be free from disease is due to tuberculosis, is by itself enough to show that the disease is fairly common in this country. It has already been stated that the true infectious nature of the disease was firmly established by the classical experiments of Koch in 1882. Subsequently the studies of Cornet indicated the probable mode of infection to be from the dust of infected rooms and the surroundings of the consumptives. Later on, Flugge brought forth strong experimental evidence of "Moist Droplet infection" during hard coughing speaking, and sneezing. Recently Behring has suggested that bovine and human tuberculosis are the same and that in most cases the infection is derived from milk during infancy. Koch's belief was that Bovine tubercle bacilli were not pathogenic to man ; but recent researches in England, America, and Germany show that the bovine bacilli are certainly pathogenic to man in certain cases, though in the vast majority of cases the infection is derived from the human bacilli in the infected sputum, whether the infection be through the respiratory tract or the alimentary tract. Professor Delepine pointed out at the Tuberculosis Conference held in Manchester last June, that 20% of fatal tuberculosis in children was due to infection through the alimentary canal, probably food, and that in 22 % of the adults dying of tuberculosis, the bacilli discovered were bovine. His conclusions are at variance with the conclusions of Koch. Dr. Nathan Raw is of opinion that the bovine bacillus is the cause of peritonitis, lymphadenitis, acute miliary tuberculosis, meningitis, arthritis and lupus, while the human variety is responsible for consumption of the lungs, laryngitis and ulceration of the intestines. It has already been mentioned that tuberculosis is caused by the bacillus tuberculosis discovered by Koch who proved that this was the one and only cause of tuberculosis. Tuberculosis is the result of the activity of the tubercle baccilli which arouse in the body various reactive changes. The disease never originates in the body apart from the invasion of the special bacilli. Without the introduction of tubercle bacilli into the system there can be no tuberculosis. The tubercle bacilli are found in the sputum or phlegm coughed up by the consumptives, in the air in the neighbourhood of the consumptives, on the surfaces of walls, floors, and furniture in the rooms occupied by the consumptives; in the clothing contaminated with the sputum, fœces, urine and otherdischarges of the consumptives, in the milk of cows affected with tuberculosis and in the cow-dung of cows affected with tuberculosis. The air of cattle yards where tuberculous cows are stabled, may contain bacilli which have been coughed up.

There are different varieties of tubercle bacilli, the human, the bovine, the avian, the reptilian, &c. Of these we are concerned only with the human and the bovine varieties. Although the bovine bacilli have been found in some of the human cases, the bovine type has little to do with consumption of the lungs. Koch's belief was that the bovine variety was not pathogenic to man. But recent researches in England and America show that the bovine bacilli are certainly pathogenic to man. Calmette in France is of opinion that it is difficult to differentiate between the two varieties.

In the vast majority of cases however, the infection in consumption of the lungs is admitted to have been derived from the human bacilli in the sputum. Actual infection requires that the infectious material should be carried from the sick to the healthy and should there find suitable conditions for its growth and multiplication.

The tubercle, the characteristic lesion of tuberculosis is produced primarily by the multiplication of the fixed cells, especially of the connective tissue and of the capillary endothelium at the site of the localization of the microbes. The cellular processes are secondary to injury to cells and to intercellular substances by the immediate action of the bacilli. The tubercles undergo subsequent softening. The slow decay or caseation, caused by the bacilli may go on especially in the lymph glands and lungs without arousing the suspicion of the individual, the parent or the physician. The disease may lie in ambush for months and years, and in this latent stage, the health, strength and the appearance may suffer but little. The disease may become quiescent at any time and it may relapse after months or years.

The tubercle bacillus is a strict parasite and is not found outside of the animal body except in places contaminated by the morbid products of the affected men and animals. Man is the chief source of danger for man. The sputum of the consumptive plays the most important part in the dissemination of the bacilli. The bacilli deposited in the streets in sputum soon lose their vitality through the action of sunlight and air. But the sputum unquestionably retains its virulence for a longer time in dark and moist places. Rooms which have been occupied by consumptives may retain virulent bacilli for at least 6 weeks. It is generally believed that the distribution of the bacilli takes place through the dried and pulverised sputum which is easily carried as dust by currents of air and is inhaled or swallowed. Flugge considers that fine particles or droplets of sputum ejected during coughing, sneezing and speaking are the chief sources of infection. The danger of the so-called droplet infection results chiefly from explosive coughing but may occur in hawking, loud talking, laughing, singing and sneezing.

Flugge, found from experiments, an average of several hundred tubercle bacilli suspended in the air, within a radius of 15-30 inches from the consumptives, within a period of 30 minutes after the act of coughing. In some cases as many as 20,000 tubercle bacilli were estimated to be present. The zone of danger extends up to 3 feet from the affected individual but is much greater during violent paroxysms of coughing. "The patient cannot help coughing and with each cough he may be projecting into the air a regular fusillade of invisible germ-laden particles which may float in the air and thence reach the lungs of the healthy and there sow the seeds of a fresh case of the disease." Engelman has demonstrated the projection of droplets to a distance of 5 feet to 10 feet. The practical bearing of the droplet infection which must be regarded as an accepted fact relates not only to the possibilities of inhalation—transmission, but as well to the added danger of food contamination. No explanation is required to demonstrate the ease with which the bacilli may be deposited upon the food, in the midst of preparation or during the course of the meal. Heymann employing an artificial spray of tubercle bacilli found that the droplets remained suspended in the air for 1½ hours. Tubercle bacilli are also disseminated by spitting into handkerchieves and by wiping the mouth after spitting with handkerchieves or dhoties. The experiments of Sormani proved—that live bacilli could be found at the end of four to six months, on cloth smeared with sputum. Hands soiled with sputum also help in the spread of infection. Living tubercle bacilli have been frequently demonstrated on the hands of tuberculous persons who are not careful in their habits. Kissing is another possible source of infection. Flies are active agents in the spread of tubercle bacilli, polluting food stuffs with bacilli adhering to their feet after contact with sputum. After feeding on sputum they evacuate the bacilli within 6 hours and some may be found in the fæces as long as 7 days.

Dr. Copman of the Local Government Board, London, has demonstrated that flies have the habit of quickly engorging themselves and overloading their crops, to such an extent that some of the fluid is ejected on alighting upon any surface. He has also stated that they utilize this fluid for moistening sugar or other dry food. He has demonstrated turbercle bacilli in the crop contents 3 days after feeding and in the fæcal deposits up to 13 days. The bacilli are distributed not only by the feet of the insect but by the vomit and the droppings as well. The infective material is taken into the alimentary tract of the fly (where the bacilli have been shown to multiply) and is subsequently deposited freely upon the food in the form of specks. As many as 5,000 bacilli have been found in a single fly speck. It has been calculated by Lord that within a period of 3 days, from 30 infected flies, 10 millions of tubercle bacilli may be deposited. When flies are fed on sputum they begin to evacuate a considerable number of bacilli in about 6 hours and continue excreting for five days.

True hereditary tuberculosis is denied by most authorities. Children born of tuberculous parents, when removed from them soon after birth, enjoy a freedom from the disease which would be impossible if intra uterine infection be common.

The actual path of infection can be by 3 routes.

(1) Inoculation.

(2) Pulmonary alveolar infection (Inhalation).

(3) Gastro intestinal infection (Ingestion with food & drink).

As a rule inoculation-tuberculosis is for the most part localised at the site of the wound, or at most spreads only to the nearest lymph nodes. More serious results are rare. Adult man is resistant to cutaneous or subcutaneous infection.

In the cases recorded of Pulmonary Tuberculosis following inoculation, it is difficult to exclude other modes of infection as well. This method can occur only in a small number of cases among medical men, nurses, butchers etc.

Until recently the theory that the infection in phthisis takes place generally through the respiratory tract was universally held.

There is no doubt that pulmonary tuberculosis is generally produced in this way. But experiments carried on during recent times prove that the gastro intestinal tract plays a very important part in the infection. Both experimental and clinical facts are constantly accumulating which prove that the digestive tract is an important, if not, the most important avenue of entry for the tubercle bacilli. Numerous investigators have shown that the mucous membrane of the various parts of the body can be penetrated by the tubercle bacilli without previous injury and without any demonstrable lesion. Entrance of tubercle bacilli and other organisms through the intestinal wall, without demonstrable lesions has been proved repeatedly. The subject has been recently studied by Calmette and his fellow workers, Symmers and Whitla, Ravenel, Guerin and Breton, Albrecht, Imlach, Baumgarten, Fischer, Wesemer, etc. Their conclusions may be summed up as follows :—

" Tubercle bacilli readily penetrate the intestinal wall without leaving any lesion. The bacilli as soon as they reach the chyle vessels, are taken up by the leucocytes which subsequently act as carriers and convey them to the relative lymph glands where they are retained for a shorter or longer time. They finally reach the thoracic duct, which in turn pours them into the pulmonary circulation. They are then arrested in the fine capillaries of the lung. Thence the ieucocytes penetrate the vessel walls by diapedesis and reach the lymphatic channels which carry them to the bronchial or mediastinal glands. Here they may die and the contained bacilli may produce lesions ; or else they may again reach the thoracic duct and the circulation. They are then carried to distant parts of the body, being finally killed by the poisons of the bacilli and arrested in the capillaries of some organ or tissue perhaps the meninges, kidneys, joints, etc., where a primitive tubercle is formed."

"The mesenteric glands present no barrier to the advance of the bacilli after the manner of the other lymphatic glands. It appears from experimental evidence that tubercle bacilli mixed with fat, penetrate the intestinal wall, pass through the mesenteric glands and appear in the thoracic duct with almost as little difficulty as do peptones after being subjected to the processes of digestion."

"In young animals the mesenteric glands retain for some time the bacilli and the leucocytes which contain them. The glands enlarge in proportion to the intensity of the infection; and the lungs become secondarily involved. In adult animals on the contrary, the glands do not retain the bacilli nearly so long, and the bacilli can be found in the lungs 24 hours after their introduction into the stomach. This difference depends upon the minute anatomy of the glands which are much more permeable in adults, than in young animals. Pulmonary Tuberculosis acquired at any age, may be due to recent intestinal infection. The location of the infection or the extent of the lesions, offer no positive information as to the port of entry. The theory of transmission of the disease through the alimentary tract does not necessarily imply the presence of the bovine bacilli as the sole or the principal agent of infection. In the large majority of cases, gastro intestinal infection is produced by the entrance of bacilli derived from tuberculous sputum. Infection through the alimentary tract is not only possible but unquestionably occurs in a large proportion of cases. In children especially it occupies a position almost if not quite as important as respiratory infection." The source need not necessarily be the milk of tuberculous cows. It may be any food contaminated with the bacilli, by infected hands, vessels, clothing, flies, etc. Infected dust which reaches the upper air passages and the mouth, is constantly swallowed with the saliva and the nasal secretion. In children, the practice of crawling upon the floor, and the instinctive habit of placing the unclean hands and a wide variety of soiled articles in the mouth, undoubtedly result in the introduction of sufficient bacilli of human origin to induce infection. In the case of the bovine bacilli, the infection takes place chiefly in childhood and is alimentary in origin. In the majority of cases, the essential element in the propagation of the disease among children is not the inheritance of the tubercular taint or predisposition from infected parents but rather an undue vulnerability of tissues peculiar to infants, and an excessive exposure to the sources of acquired infection.

The opportunity for receiving the tubercle bacilli into the body from outside, begins with birth, and the means of transmission are numerous in infected surroundings. Breast fed infants can readily get the bacilli from the sputum-soiled fingers of the mother, which are frequently in contact with the nipple put into the infant's mouth. Next in importance are the fingers and toys of the creeping infant frequently soiled (as they certainly must be in the dwellings of the consumptives), with the infected dirt of the floor, the infected clothing etc. Sputum may be brought into the uninfected houses on shoes, trailing garments, walking sticks, and by pets like dogs.

Bacilli have been found to be frequent on the hand and under the nails of children in consumptive families. Bacilli are decidedly most virulent in the moist condition and it is conceivable that the hands may convey them frequently from parent to child—indirectly by food, confectionery, drinking cups, towels, etc. The act of kissing on the lips is dangerous to children. Even for adults the opportunities for an initial invasion through the digestive tract are by no means inconsiderable.

In my practice I find that one of the earliest symptoms of tuberculosis of the lungs is dyspepsia (want of appetite, nausea, weak digestion, etc.) and this seems to point to the probability of the infection through the alimentary tract. Recently, Captain Ingram of the General Hospital has drawn attention to the presence of tubercular lesions in the intestines, in bodies in which no other sign of tubercular infection can be detected (in the lungs or elsewhere). The human sputum is the greatest factor in the dissemination of the bacilli whether by direct transmission in the moist condition or through the medium of dust in contaminated rooms or of food, clothing or other objects. Urine and fæces and infected pus from discharging sinuses doubtless play some rolê in the transmission of the disease, indirectly, through soiled garments, and bedding, as well as through the unclean hands, in the case of the advanced consumptives.

In a large proportion of cases the urine of consumptives has been found to contain tubercle bacilli even without clinical or pathological evidences of genito urinary tuberculosis. In the Phipp's Institute tubercle bacilli were found in the urine of 44 out of 50 patients with Pulmonary Tuberculosis. Recent researches tend to indicate that the bacillus is not infrequently present in the fæces despite the absence of tuberculous sputum or intestinal involvement. Rosenberger found tubercle bacilli in the fæces of 26·6 per cent of tubercular patients. The hands of consumptives and the attendants accustomed to handle the sputum and soiled clothing, have been found to contain tubercle bacilli. Beard and moustaches are effective means of bacillary distribution. We cannot deny the possibilities of infection arising from sputum dust, whether it is deposited on the floor, carpets and mats, or on clothing, handkerchieves, hands, beard, etc. The careless and indiscriminate agitation of dust incident to the ordinary methods of house cleaning is sufficient to effect an introduction of bacilli with the inspired air, food, etc. The vitality of the bacilli, in walls, floors, carpets, etc., not exposed to direct sunlight is continued for an indefinite period. When subjected to continuous agitation by draughts, rustling of clothing, sweeping and dusting of rooms, the bacilli have unusual opportunities to find entrance into the body. The principal means of dissemination of the bovine bacilli is the ingestion of unboiled infected milk. The eating of tuberculous meat is of less importance, partly on account of the inspection of the meat in slaughter houses, and partly on account of cooking. The bacilli may be conveyed to milk from the diseased udder or through the medium of the animal fæces. In this country milk, as it is boiled before use, is not a source of infection. But the cow-dung may possibly be a source of infection in this country as particles of cow-dung dry or moist, are to be met with in utensils, floors, and even food, and as they are not considered dirt (cow-dung is supposed topurify all forms of dirty matter by its contact).

American observers note that 40 per cent of cows exhibiting a positive tuberculin reaction without other evidence of infection are scattering tubercule bacilli broadcast, through the fæces. A tubercular cow is said to discharge daily with the fæces about 37,800,000 virulent bacilli, capable of microscopic detection and many times more, not thus demonstrable. This infected dung is deposited in the stalls. On account of the general uncleanliness of the stalls and on account of the almost unavoidable soiling of the tail and the abdomen of the cows, the milk is likely to be easily contaminated. The bacilli may also be ingested with butter, the active virulence of the bacilli not being diminished during a period of about 7 weeks. The bovine bacilli may also be distributed during the act of coughing.

I have already mentioned that the number of people suffering from tuberculosis in the City of Madras may be taken as 8000. This might seem an exaggerated statement to the laity. But it is easily intelligible when we remember that it is very common for the apparently healthy, to carry about with them tiny tuberculous foci with living but dormant bacilli ready to break out afresh if the defences of the body are weakened, but incapable of mischief so long as the health remains good. In most cases tuberculous disease breaks out after a period of latency, of uncertain length in consequence of some indiscretion or illness, or a feat of endurance apt to overstrain the constitution. In a good many cases we often wonder how the patients could have got the infection. Behring is of opinion that all infection takes place during childhood and that the primary infection is invariably bovine and that the bovine and the human bacilli are identical. This is of course an extreme view. The following extract from a paper by Pottenger of California in the New York Medical Journal will give us an explanation of the sources of infection under the circumstances. "Tubercular infection is very common in early childhood. A large proportion of those patients, who although infected, do not show acute symptoms during childhood, develop active tuberculosis in later life. In seeking the course of the frequent infection, aside from the habits of the child and the carelessness of the parent, bringing it in frequent contact with the bacilli, all those things which lower vitality at this time must be considred. There is a connection which seems more than coincidence, in the time when the tuberculous infection takes place and the time when the child is most apt to suffer from catarrhal conditions of the stomach and the bowels. All tuberculous children whether they have lesions in the glands, bones, lungs or any other part of the body should be treated for this disease. That a focus of infection may lie dormant in the system enclosing bacilli which are virulent, is shown by fact that the disease can be produced by inoculating animals with the gland of individuals in whom there are no obvious symptoms of disease. Another proof is the usual manner in which the disease often starts up, after an acute illness, when no opportunity for a fresh infection could have occurred. The only satisfactory manner of accounting for the symptoms at these times is to suppose a previous infection and recognise the possibility of the bacilli lying in a state of quiescence." Pottenger holds that tuberculosis is primarily a glandular disease (the bacilli gaining entrance through the mucous membrane and being either destroyed or deposited in the lymph glands) and that the bacilli may find a way to other parts of the body from the infected glands. That tubercular infiltration may remain for a long time without ulceration is proved in the case of the larynx. In former years susceptibility to consumption used to be entirely attributed to inheritance. But in recent years, that view has been given up. Inheritance does count for something, in as much as a weak constitution predisposing not only to tuberculosis but also to other diseases, can certainly be inherited. But the manner and condition of life and exposure to infection especially in early childhood count for very much more. Some infectious fevers, *e. g*, measles, whooping cough, influenza and typhoid fever cause an unusual tendency to tuberculosis. The commonest predisposing cause is a life under unhealthy conditions. Ill-ventilated, overcrowded rooms, over indulgence in alcohol, late hours and irregular habits, predispose towards the disease, as also do starvation and over work, (although in these cases dust and dirt and intimate association with careless or ignorant consumptives also play an important part.) It is especially common in women exhausted by too frequent pregnancies, prolonged suckling or prolonged sick nursing without a proper amount of rest and food. A Sedentary life (and the consequent imperfect expansion of the lungs due to want of exercise) an excess of any kind, bodily and mental fatigue, emotional excitement, worry, reverses,sexual excesses, insufficient food and sleep, are all powerful predisposing causes. They act by weakening the natural resistance of the body to infection, by the tubercle bacilli. Tuberculosis is so largely a house disease that the importance of the house infection can hardly be exaggerated. The opportunities for infection both for children and adults, are innumerable not only in the houses of the poor but also those of the wealthier classes in this country ; partly on account of the bad ventilation and lighting, partly on account of the delay in the recognition of the disease both by the patients and by the medical men, and partly on account of the ignorance of the infectious nature of the disease.

Tuberculosis in the early stages is an easily curable disease and is not infectious, but in the later stages it is incurable, hopeless, and highly infectious. The curability of consumption, if discovered and treated early, was known even to Hippocrates 318 B. C. Treatment in an early stage will often restore the man to full working capacity but in the later stages, even if he recovers, the consumptive will often be an invalid for the rest of his life, unable to do any active work. When the recovery is incomplete, much will depend on the conditions of life after apparent recovery. It is during the earliest stages, before tubercle bacilli have appeared in the sputum (when the patient is merely run down or suffering from debility or weak lungs or some other vague ailments) that the results of systematic treatment are best seen and are likely to be most brilliant. So long as the change in the lung is confined to a few scattered tubercles and the constitution is not undermined there is no reason why the recovery should not be complete. In the later stages the lung tissue breaks down and it is impossible to replace the lung tissue that has been destroyed. Incomplete recovery of the lung, leaves smouldering patches of tubercle behind, which are capable of breaking out afresh, at the least encouragement even if the patients survive. Therefore it is a matter of great importance to make an acurate diagnosis of pulmonary tuberculosis in the early stages both in the interest of the patient and the public. The early consumptive does not discover himself. He has to be sought out by the physician. It is exceptional to have actual illness in the early stages of tuberculosis, unless this follows influenza, pleurisy, pneumonia, whooping cough, typhoid fever or other acute diseases. In this connection may be noted the interesting observation of Col. Roberts that some of the cases of typhoid fever in which one does not obtain a positive widal reaction are really early cases of tuberculosis and that they react to the tuberculin tests.

The disease usually begins insidiously, with slight debility or lack of tone which cannot be thrown of when a holiday is taken. There is perhaps, a little difficulty in doing physical or mental work against time, possibly a tendency towards irritability of temper or to restless nights, lack of appetite or dyspepsia.

Malaise is one of the most constant symptoms of early tuberculosis. Patients complain of being run down. They have a feeling of languor, being more or less tired without apparent cause. Tasks (physical and mental) ordinarily performed easily, become difficult. Sleep is disturbed and does not bring proper rest. The early consumptive does not seek for medical advice as a rule. He has to be sought out particularly in the houses of late consumptives who come in for treatment.

Persistent debility, Neurasthenia, persistent dyspepsia, slow recovery from acute diseases, persistent pallor or anemia, unaccountable giddiness, persistent cough, progressive loss of weight, frequent attacks of cold or bronchitis, change of temper, change of the voice, rise of temperature after meals or after slight exercise, rise of temperature in the afternoons, sensation of heat in the face in the evenings, palpitation, dyspnea, sensation of feverishness even when the thermometer readings are normal, enlargement of the lymphatic glands, loss of weight, rapidity of the pulse (more than is warranted by the temperature) obscure pains in the chest, profuseness of the perspiration (especially from the armpits during the examination), imperfect expansion of the chest, retraction of the chest above and below the clavicles, bloodspitting, are all symptoms which should rouse our suspicion and make us investigate the cases thoroughly. None of these symptoms are specific and they may be found in various other diseases. But when they are persistent and cannot be easily accounted for, we must remember the possibility of tuberculosis.

In the late stages when tubercle bacilli can be demonstrated in the sputum and when the physical signs are very definite, the diagnosis is easy ; but the condition of the patient by that time would be serious. In really early stages, there would be no well marked alterations discernible in the lungs, so that careful attention to the clinical history, family history (as pointing to the possibility of infection) the temperature record, the rise of temperature after exertion, the X Ray photograph of the chest, the opsonic index, the tuberculin test and a thorough clinical examination of every physiological system will help us in diagnosing early tuberculosis.

The appearance of the tubercle bacilli is by far the most decisive evidence ; but the presence of the bacilli indicate softening in the infiltrated areas. This evidence is thus obtainable only in the late stages when the patient has become infectious.

The appearance of bacilli in the sputum is tardy and it is preceded by the physical signs of the first stage (Turban I) often complete enough to establish the diagnosis. Bacilli can be found only in open tuberculosis. And it is the duty of the physician to see that closed cases of tuberculosis are not allowed to proceed to the open stage. It is usual on the part of many physicians to consider the apices of the lungs as the only spots likely to be affected in early tuberculosis and examine only the apices in suspicious cases. But my experience is that the roots of the lungs and the apices of the lower lobes are found to be affected very early in the disease. In suspicious cases, I am not satisfied with the examination of the apices alone. I pay particular attention to the whole of the chest, front and back, and particularly to the interscapular region. It is not unusual to find a change of the percussion note or roughened or cogwheel breathing or feeble breathing or dullness with a tympanitic component, loss of resiliency under the pleximeter finger over the lung affected. Care should be taken not to mistake a muscular sound, sometimes met with in deep inspiration about superior angles of the scapulæ and the supra spinus regions, for cogwheel breathing. Sometimes a click at the end of the inspiration (sometimes after a cough) is the only abnormality met with.

In an article contributed to the Practitioner (February 1912) Dr. Jordon, radiographer of Guy's Hospital, pointed out that frequent X ray examinations revealed to him the fact that the disease was confined to the region of the roots alone (the apices not being affected) in a large proportion of cases (40 p. c.) examined. From clinical evidence I think his observation is quite correct.

The disease usually begins insidiously and is often wrongly diagnosed in this country. In the early stages, the disease is commonly mistaken for Malarial fever or Bronchitis or Asthma, or Broncho Pneumonia or Neurasthenia or ' Pyrexia of unknown origin' and treated as such, till the patients become hopeless infectious consumptives. Even in advanced cases, the evening chills of the septic type of tuberculosis are mistaken by some for the rigors of malarial fever in spite of the absence of the malarial parasites from the blood.

It is quite possible for tuberculosis to co-exist with malaria in the same individual. If malarial parasites are found in the peripheral blood, the general practitioners would be satisfied with the diagnosis and miss the diagnosis of the co-existent tuberculosis. I have found that the benign tertian parasites when present in a Phthisical individual are not easily eradicated from the system. They stick to the system for many years. Before I took up the study of tuberculosis, my impression was that the benign tertian parasites could be easily eradicated from the system by quinine administered by the mouth or hypodermicaly (when the oral administration failed); but during the past few years I have come across 5 cases of consumption complicated with benign tertian malarial fever in which I found that the vigorous administration of quinine gave only temporary relief and that the parasites and the fever would disappear only for the time being. After a month or two (very often three weeks) fresh paroxysms of typical malarial fever (benign tertian parasites could be demonstrated again) occur. I am at present of the opinion, that, if benign tertian parasites are not easily destroyed by quinine, the patient may possibly be suffering from co-existent tuberculosis. (Malignant tertian parasites have not been found by me in cases of consumption.

I will here give short notes of cases pulmonary tuberculosis complicated with malaria.

Case 6. A young man aged 28 years, came to me suffering from fever, anorexia, diarrhœa, dyspnea on exertion, anemia and emaciation. He had been treated for some time by a general practitioner for gastro intestinal irritation. I found an admission that his temperature was subfebrile and that the daily range of temperature amounted to 1½ degrees to 2 degrees F. On the right side of the back, there was dullness on percussion down to the level of the lower angle of the Scapula. The vocal resonance and the vocal fremitus were increased and the breathing was of the cogwheel character. The tuberculin tests (both conjunctival and cutaneous) were positive. Though the family medical adviser who had sent him on, had little hopes of saving him; I considered it a fair case for tuberculin injection.

A week's rest in bed brought down the maximum evening temperature to 98·8 degrees. The first injection of new tuberculin went off all right. The dose was increased on the fourth day and the temperature was normal on that day. But on the next day the maximum was 100·6 degrees. I naturally attributed it to the reaction following the injection and was inclined to think that the dose was probably a little too large. As the temperature on the third day was normal I thought my supposition was probably correct. But on the fourth day the temperature rose to 104 degrees in the evening. 4 grains of Phenacetin brought down the temperature to 99 degrees. The next morning the temperature was 96 degrees in the morning and 103·6 degrees in the evening. I was sorely puzzled for an explanation and could only treat the fever symptomatically. The family Medical adviser was frightened and told the relatives to telegraph for the eldest member of the family as he thought the patient would not survive for many days. The next day the temperature was normal and the true solution dawned upon my mind. I told the relatives that in my opinion the rise of temperature was due to malarial fever and that there was no room for anxiety. But before the administration of quinine, I wanted to satisfy myself both clinically and microscopically that the fever was really due to malaria. After two more paroxyms, I gave a hypodermic injection of quinine which prevented further paroxysms of fever. It is needless to state that I found malarial parasites (Benign tertian). See fig. 1. I repeated the quinine injection later on (after a fortnight) and the subsequent course was uneventful. When I went into the previous history of the case I found that he had had weekly attacks of fever for a few months, seven years before his admission and *monthly attacks of fever lasting two or three days* for two months, in the year previous to admission.

This monthly periodicity of the malarial fever was subsequently noted by me in other cases. It might be asked why I did not examine the blood for malarial parasites at the first instance, as the patient came on with fever. As the definite physical signs in the lungs and the symptoms left no doubt in my mind as to the nature of the illness and as both the tuberculin tests were positive, I was satisfied that pulmonary tuberculosis was the cause of the fever. Moreover it was the first case in which I met with a combination of malaria and tubercle. Since then I have been examining the blood of all cases of tuberculosis coming to me for malarial parasites. See Fig. I.

The next case shows that even an examination immediately after admission may fail to help one in a puzzling situation.

Case 97—one of three tuberculous sisters. Girl of 18. A case of scrofulous glands with suspicious physical signs in the right lung. Came in with cough and low fever of which she was unconscious. The cutaneous tuberculin test was positive giving rise to severe ulceration. The conjunctival test was omitted as the corneæ and the conjunctivæ were not healthy. The blood was examined for malarial parasites. But no parasites could be found. The slide was examined carefully by me first and subsequently by a fellow practitioner, skilled in blood work. The temperature steadily kept up at 100° and above. Rest in bed had no effect in reducing the temperature ; after a week, the maximum temperature was found to go higher on alternate days ; and when it rose for a third time, I made up my mind to reexamine the blood for malarial parasites, in spite of the fact that I failed to demonstrate the parasites only a week before. As a few parasites were found after searching the whole slide,quinine was administered by the mouth. Subsequently the temperature came down lower, though not to the normal. The injection of new tuberculin later on, brought down the temperature to the normal. See Fig. II.

Case 79—A Medical student, aged 21. Had been treated for malaria 12 months before admission.

He came to me with fever and cough and a history of hœmoptysis and definite physical signs (the whole of the upper lobe of the right lung being affected). The cutaneous tuberculin test was positive. He refused to have the conjunctival test done. Rest in bed for two weeks brought down the maximum temperature to 99-99·4 degrees. Then tuberculin injections were started and the first nine injections went on satisfactorily. On the fourth day after the ninth injection, the temperature rose to 100·2 degrees and this rise was supposed to be due to the oil bath taken on that day. As the temperature next day was normal a tenth injection was given. On the day after injection the temperature rose to 103 degrees. The boy a medical student, himself got frightened. The father, a medical man seemed to have shared his fright as he ran home to me next morning with a blood film and a woeful countenance. The father did not evidently believe in his heart, that the rise was due to malaria, though he had calmed the anxiety of his boy, by stating that the rise was malarial. I examined the slide and found benign tertian parasites and filarial embryos. Quinine was administered by the mouth daily for about a week and then from time to time. See Fig. III.

Case 53. A cousin of case 6 described before, came with low fever, cough, and giddiness. The chart shows the sub-febrile temperature and the long temperature range, characteristic of tuberculosis (1½° to 2°). While under treatment, she suddenly got high fever on alternate days. As the blood on examination revealed benign tertian parasites, quinine was injected into the deltoid, my favourite site for quinine injection (I may state here, that in my experience 2 or 3 weekly intramuscular injections effectively kill off malarial parasites in benign tertian cases, uncomplicated by tuberculosis.) The injection stopped the fever but I was able to demonstrate the parasites 24 hours after injection. They were all big mature gametes. (Are these gametes more resistant to quinine than the young forms found in the blood immediately after the sweating stage. In olden days before the discovery of the malarial parasites, the classical treatment was to give blue pill or calomel and black draught first, and then give quinine after the sweating stage when the temperature had become normal. This old fashioned treatment seems to me to be better than the present fashion of giving quinine as soon as one has demonstrated the parasites under the micrcoscope).

April 16th	Attack
27th	quinine injection
May	No attack
June 6th	attack after 7 weeks
26th	quinine injection
July	No attack
21	quinine
August 8th	attack after 8 weeks.

The case was shown to Col. Donovan who was able to see only benign tertian parasites, Col. Donovan told me that quinine by the mouth if continued for a long time would act better and I so prescribed 5 grains of quinine bihydrochloride twice a week for 2 months. During the next 3 months she did not get a fresh attack of fever. As she left Madras, I could not make further observations. The latest report is that she gets occasional slight rises. The chart shows the presence of the tubercular fever and the superadded malarial fever. See Fig. IV a & b.

Case 14. A school boy 19 years of age. (While he was in his 16th year, his father had expressed his anxiety about the poor development of the boy. The boy had been examined by me and Col. Browning and both of us had a slight suspicion of tuberculosis. On questioning the father I learnt that the mother of the boy had died of consumption. I then gave the time honoured advice of "plenty of fresh air and good food." Two years later the boy was taken along with his brothers during the midsummer holidays to Yercaud where he contracted severe malarial fever. The boy suffered from hyperpyrexia and was unconscious for a day or two. His condition was very critical for a few days. Luckily the boy got over his trouble and returned to Madras to prosecute his studies. But from time to time he was getting attacks of malarial fever. Benign tertian parasites were found in the blood on each occasion.) On each occasion, quinine was administered intra-muscularly and the injection was followed by quinine in solution (6 to 10 grains per day) by the mouth, for a week. As the fever appeared again in the 4th month, he was put on a pill containing quinine, iron, and arsenic for some time. But when the fever re-appeared in the 5th month I began to suspect tuberculosis especially as his mother had died of it and as I had suspected it two years earlier. He gave a positive reaction to Von Pirquet's cutaneous test. On examination, I detected the following physical signs :—

Infra-clavicular bilateral flattening of the chest near the outer ends of the clavicles, dullness in the right supra-clavicular region ; dullness along the vertebral border of the right scapula, and a patch of dullness size of a rupee about the lower angle of the left scapula. Nothing definite could be made out in the breath sounds. He was very emaciated. (A year later I found another brother suffering from pulmonary tuberculosis and the father suffering from tuberculosis of the kidney). As the diagnosis was clear, tuberculin injections were commenced, and during the course of the injections, attacks of malarial fever used to occur from time to time. The monthly periodicity of the malarial attacks was striking. For the first 6 months I have no record and I can only state from memory that every month he used to get high fever for 2 or 3 days with the typical cold, hot, and sweating stages. The attacks during the last 5 months of his stay in Madras are shown in the accompanying chart.

January 16—20	attack of fever.
February 20	do.
March 16th	do.
April	Nil as I gave a quinine injection in anticipation of an attack.
May 21	Attack.

See Figs. V and V A.

I have entered into some of the details of these cases of combined infection, to show that Benign Tertian parasites are not easily killed in such cases and that the malarial attacks if they occur within 3 days after injection, are likely to produce confusion and make it difficult to say whether the high fever is due to an over dosage (which is dangerous) of tuberculin, or malarial parasites. Frequent malarial rises of temperature give considerable difficulty in adjusting the doses of tuberculin to the patient, and must be controlled before one proceeds further.

Sometimes, cases of tuberculosis are mistaken for asthma or chronic bronchitis. In many text books one finds the statement that asthma and tuberculosis of the lungs cannot co-exist. But I have come across cases of pulmonary tuberculosis which had been diagnosed as asthma by the previous medical attendants. The diagnosis of pulmonary tuberculosis is missed, if one pays attention only to the spasmodic wheezing respiratory sounds.

Dr. Burton Fanning of the Kelling Sanatorium states that he has found in 3 % of his patients, pulmonary tuberculosis with asthma, and chronic bronchitis with emphysema. Mitchell Bruce also points to the danger of over looking tuberculosis in the presence of emphysema and bronchial catarrh. He draws attention to the fact that the diagnosis is usually made on the failure of the usual remedies for the bronchial condition to give relief, on the supervention of the evening fever, emaciation and debility on the former symptoms and on the eventual discovery of tubercle bacilli in the sputum.

What are the characteristic symptoms of asthma or chronic bronchitis when they have existed for some time?

1. The spasmodic attacks which last for a few days and which are succeeded by intervals of comfort.

2. The marked prolongation and wheezing of the expiratory sounds.

3. The barrel shaped chest.

4. The tympanitic note on percussion and the absence of dullness on percussion.

5. The absence of flattening of the chest.

6. The absence of emaciation.

7. The absence of evening pyrexia.

All these characteristics are absent in cases which pass muster under asthma but which are really tubercular.

The possibility of the co-existence of chronic bronchitis with emphysema and pulmonary tuberculosis cannot be denied.

Case 60. Had asthma for a long time. On admission she was found to have an emphysematous chest and the breathing was wheezing. She gave a history of frequent attacks of Hæmoptysis and complained of pain over the left side of the chest in the front. She had a rise of temperature and an excerbation of the dyspnea and hæmoptysis during the menstrual periods. On account of the emphysematous condition, no definite physical signs pointing to tubercular affection of the lungs could be made out. There were no tubercle bacilli in the sputum. The Von Pirquet cutaneous test was positive. The temperature was sub febrile. She *improved under tuberculin injections* which had to be alternated with auto-vaccines after 2 months. See Fig. VI.

Case 21. Had been treated by most of the practitioners in this city for asthma for many years. When he came to me I found he was very much emaciated in spite of the treatment and had two large cavities in his lungs one on each side. He was suffering from diarrhœa, cough, fever and difficulty in breathing. I could not understand how he could have been treated for asthma. The tuberculin tests both conjunctival and cutaneous were positive and the temperature is shown in the accompanying chart. (Fig. VII.)

Case 38. A young clerk of 30 years, with a history of asthma. On physical examination he had typical asthmatic wheezing expiration. He came with a complaint of cough and weakness though he looked stout. Near the lower angle of the left scapula there was a patch of dullness where vocal resonance and vocal fremitus were increased. Fine crepitations were heard all over the back and all over the front of the chest. He had fever of which he was not conscious. Tubercle bacilli were not found in the sputum and and the tuberclin tests cutaneous and conjunctival, were negative. Repeated after 10 days those two tests were negative again. But the continuous pyrexia and the patch of dullness at the back had to be accounted for. So I applied Koch's sub cutaneous test. The reaction was positive. He was consequently declared tuberculous and was submitted to the tuberculin injections for about 8 months. At the end of the course he got rid of his asthma, fever and weakness and had put on 22 lbs. He had also lost the instability of the temperature and was able to take long walks without any rise of temperature. In my opinion he could have continued the injections for another 3 or 4 months as the range of temperature was nearly 2 degrees, but as he could not afford to stay longer, he had to be discharged. See Fig. VIII.

Case 89. (See fig. IX). A young student who gave a history of repeated attacks of cough and fever lasting four to six months on each occasion. He came to me with his uncle to get himself examined as he had been coughing for sometime. The infra and supra clavicular regions on both sides were hollow and the chest was flat. Moist rales of medium size were heard all over the chest. In the back the interscapular region was distinctly dull on percussion on both sides. I placed my thermometer in his mouth, when the uncle protested the boy had no fever. The patient also told me he had no fever. I satisfied them by saying that I did it out of curiosity to know what the normal temperature was in this case. When I took out the thermometer after 5 minutes, it recorded 100° to the amazement of the patient and the uncle. I asked them to take a daily record, morning and evening for a few days. The cutaneous and the conjunctival tests were applied. Both the tests gave very marked reactions. The boy was seen by a fellow practitioner who diagnosed the case as consumption. The accompanying chart shows the course of the temperature. Later on tuberculin treatment was commenced. During the course of the treatment, he had two typical attacks of spasmodic asthma, on two days on which he was injected. If I had been called in to see him, only during those attacks and asked to diagnose the case by auscultation only, I myself would have diagnosed the case as one of typical spasmadic bronchial asthma. But the fever rose on those two occasions. On enquiry I found the boy had been subject to attacks of asthma. Then I had to give five injections with an auto-vaccine before resuming the tuberculin. After 15 injections of tuberculin I found that the lung conditions had improved considerably and that the temperature had become normal.

I have come across other cases of this sort. Some of these are probably cases of fibroid phthisis (?) In one case I was able to demonstrate tubercle bacilli and in another case I was able to demonstrate cavities (developed at a later stage) to a fellow practitioner. My reasons for classifying these cases as tubercular are

1. The *continued* pyrexia (even in the intervals between the paroxysms.)
2. The presence of fever which is not felt by the patient (a characteristic of tubercular fever).
3. Positive reaction to the tuberculin tests (conjunctival and cutaneous).
4. The absence of an emphysematous barrel-shaped chest.
5. The absence of a tympanitic note on percussing the chest.
6. The flatness of the chest and the emaciated appearance.
7. The dullness of the note on percussing the chest.
8. The wheezing during *inspiration* (at times).
9. The absence (in some cases) of prolongation in the expiratory sound.
10. The predominance of moist rales instead of sonorous and sibilant rhonchi.
11. The absence of the protruding eye-balls in the chronic cases.
12. The improvement under tuberculin injections.

The phlegm is fairly abundant in some of these cases but as it is sticky the patient is troubled with severe fits of coughing. The fits are caused not by the spasm of the bronchioles but by the sticky nature of the phlegm which refuses to float off the surface of the bronchial mucous membrane. The coughing fits are generally severe in the mornings. This class of cases requires further study and observation. The cases improve under tuberculin injections up to a particular limit. Then it is necessary to combine the use of auto-vaccines with tuberculin to produce further improvement. Even then, there is a limit to the improvement obtainable. But the disease seems to extend very slowly.

I have gone into these cases in some detail in order to attract the attention of the profession to the study of these cases.

A wrong diagnosis in the early stages *when only* the disease can be completely cured, is detrimental to the interests of the patients as well as of the public. The patient whose condition has not been properly diagnosed, rapidly passes on to stages II and III of Turban and begins to expectorate millions of bacilii in his sputum. His condition becomes hopeless and he becomes a source of infection to the public. The wrong diagnosis is not always due to lack of skill on the part of the medical men but to their disbelief in the wide prevalence of the disease in this country. Some of the European medical men seem to hold the view that tuberculosis of the lungs runs a very rapid course in this country. But I differ from this view. People in this country do not resort to the hospitals and the European doctors in the earlier stages of the disease. In the very early stages, the consumptives neglect the complaint as it does not interfere with their work and in the later stages they resort to the so-called native treatment of the Vythians and Hakeems. When however they find, they are not improving, they resort to the Hospitals or consult qualified medical men. By this time, the condition becomes hopeless and the downward progress is very rapid.

In the earlier stages many of the tubercular patients are unaware of the fact that they are suffering from fever till it is demonstrated to them by the thermometer. Many a time have I found a temperature of 100° and 101° in patients coming to me with a history only of cough and anorexia, though they denied the presence of fever. The tuberculin circulating in the body probably acts as a stimulant and makes the patients unconscious of the fever. The patients in stage I of Turban refuse to believe that they are ill enough to require any treatment. Even in the later stages (stage II) I often find it difficult to convince the patients of their serious condition. Patients suffering from complaints other than tuberculosis, are often desirous of making out a case worse than is actually the case, while the tubercular patients make light of their complaint and refuse to believe that they are ill. It is often amusing to see the tubercular patients attempt to explain a rise of temperature when it is demonstrated by the thermometer. Ask a tubercular patient whether he had been getting fever and he would say "no." Place a thermometer in his mouth for five minutes and show him the reading say 99·5 or 100°. He will tell you that the rise is due to a drive to your house or want of sleep in the previous night or a railway journey or severe study. He is ready with an explanation for the rise, and wants you to believe that he never had fever. I don't deny the possibility of the temperature being raised by such causes. But such sensitiveness of the temperature is to be found only in the tuberculous. You ask these patients to take rest and record their temperature every four hours for a few days before seeing you a second time. How do you find them at the next visit? They are now convinced that they do suffer from a low fever. They come and tell you that they are really suffering from a low fever and that they were ignorant of their condition as they had not made careful thermometric observations before.

Loss of weight, a poor appetite, dyspepsia, a feeling of great exhaustion, frequent attacks of colds, chronic cough, a persistent low fever in the evenings (it may be only 99·2 or 99·4 evening after evening) that cannot be accounted for, a subnormal temperature in the morning and a great difference between the morning and the evening temperatures (amounting to 1½-2°) a burning sensation in the face or extremities, கணச்சூடு, are all very important factors in the diagnosis of early tuberculosis.

In suspicious cases, we must very carefully examine the family history, the previous history and the two hourly temperature record and make use of the tuberculin tests (if tubercle bacilli cannot be demonstrated in the phlegm.)

The temperature chart plays an important part in the diagnosis, the prognosis and the treatment of consumption. It may not be out of place to discuss here, the various questions relating to the temperature of the patient.

What is the normal temperature of the body ?

Where is the temperature to be taken ?

How is it to be taken?

Is there anything characteristic about the temperature of tuberculosis?

What part does the temperature play in the prognosis ?

In tuberculosis a rise of temperature to the extent of even 0·2° to 0·4° is a matter of great significance in the diagnosis, prognosis and treatment. Hence too much importance cannot be attached to a carefully kept temperature record. As it is necessary to know the presence of even slight variations, an accurate half minute thermometer must be employed. I generally ask my patients to provide themselves with a half minute thermometer (of Hick's make) which is accurate enough for my purpose and costs only 3 Rs. four annas. I often compare the readings of the patient's thermometer with a reliable one of mine, in the beginning. As the readings have to be taken and recorded by the patients themselves it is necessary to see that the divisions of the scale of the thermometer are far apart and that the thermometer is provided with a magnifier.

The armpit is an unsuitable place for placing the thermometer in tubercular cases, as slight rises cannot be detected in this way. The temperature here rises very slowly. Phthisio therapists all over the world are in the habit of taking the temperature in the mouth or the rectum. Most of the sanatorium people, prefer the rectum. No doubt the rectal reading is the most accurate. But it is disagreeable to the patient and is practicable only in sanatoria. It necessitates privacy and undressing of the clothes, each time the temperature is taken (and the temperature has to be taken at least five or six times in the day).

The oral temperature when taken properly, has been found to be 0·4° F. higher than the rectal reading by a series of observations in the Kelling sanatorium by Dr. Burton Fanning.

Taking the temperature in the mouth is the most convenient method. But certain precautions must be observed if the temperature is to be reliable.

1. The index should be lowered to 96° before placing the thermometer in the mouth.

2. The temperature should not be taken within half an hour, after eating or drinking anything or washing the mouth, or after exercise. One can easily understand that the mouth will not record the true temperature of the body if anything hot or cold, had previously been swallowed. The effect of exercise on the temperature and the subsequent fall to the normal, in health, within thirty minutes is shown in the accompanying figure.

Case 74.

	Immediately after exercise	After 30 minutes' rest
10th July 1912	99·6	98·4
11th ,,	99·8	98·6
12th ,,	99·4	98·2
13th ,,	99 8	98·4

3. The thermometer should be kept *under the tongue* and the mouth should be kept well closed.

4. The thermometer should be kept in the mouth for at least five minutes, preferably 7-10 minutes, however rapidly the thermometer registers. I have been able to prove to the satisfaction of many of my patients that there is a difference of $\frac{3}{4}$°-1° F. between the reading shown after keeping the thermometer for two minutes, and the reading shown after keeping it for five minutes.

Five minutes should be the minimum time during which the thermometer should be kept under the tongue, though the thermometer may be a half-minute thermometer. What is the normal temperature in the mouth in health ? There are not many observations on this point even in Europe. I have not been able to come across many definite statements in the literature of the subject.

It is a tiresome task to take the temperature five or six times a day, keeping the thermometer five to ten minutes in the mouth each time and very few healthy men can be induced to do that.

The temperature of my tuberculous patients in stage O, and stage I, just before discharge, after a course of injections may be considered normal.

The morning temperature is of course the lowest and varies from 97·8 to 98·4 F. and the evening temperature varies from 98·4 to 98·8 F. The maximum is reached between 3 P. M. and 5-30 P.M., generally at 4-30 P.M. I have come to consider 99·5 F. as distinctly abnormal. I consider 99° in the evening as the extreme limit of health. I don't consider a patient cured unless the temperature in the evening is below 99° F. and the morning temperature above 97·6°.

SEE CHARTS. XI TO XVII.

In Dr. Walther's sanatorium at Nordrach, it was found by Dr. Delany that the rectal temperature (while the patients were at rest) was 97·5 at 6-30 A.M.

98·5- 98·8 at 11 A.M.
98·5 - 98·8 at 5 P. M.
97·5 at 10 P.M.

Dr. Denys considers 98·6° in the mouth as abnormal. The normal temperature according to him is 96.9 to 97.3 in the morning, and 97.9 to 98.4 in the evening. Turban considers 98.9 (oral) as the extreme limit in health. The temperature of the tuberculous patient is very unstable. Gentle physical exercise, emotional excitement, bad news, prolonged talking, or writing, excitement of any kind, menstrual periods are all likely to raise the temperature. See Figs. XVIII, XIX, XXIII, XXIV, XXV, and XXVI

I have also added 2 charts from Mark Patterson's book on Autoinoculation which are very similar to the charts of my patients. See charts XXI and XXII.

The fever of tuberculosis is characterised by certain peculiarities.

1. Chronicity.

2. Afternoon rise.

3. Subnormality in the mornings.

4. The great difference between the minimum and the maximum, amounting to 1½° to 2°. See Figs. XXVII to XXXII. In health the range should not exceed 1 degree F.

5. Instability. The temperature is easily raised by physical or mental work, excitement, bad news &c. and does not settle down for a long time.

6. The frequent imperceptibility of the fever by the patient. The slight discomfort felt by the patient, during the evening rise, makes him ignore his condition till it becomes serious. I have often found patients going about their work, in ignorance of their febrile condition even when the temperature is 101° to 102°.

7. It has been stated by many authors that there is a premenstrual rise of temperature in tubercular women. I have seen a very considerable rise of temperature in some cases. But in milder cases under treatment with injections, there is a fall of temperature during the period, see Figs. XVIII, XIX, XX, XXI & XXII. To have an accurate idea of the temperature variations it is necessary to take the temperature at least every 4 hours. I prefer the hours:

6 A. M.	10 A. M.	2 P. M.	5 P. M.	9 or 10 P. M.
immediately after rising	before bath or breakfast	before tiffin		before going to bed.

In some cases, I ask for an extra reading at 4 P. M. Some cases of tuberculosis at rest may have a normal temperature. The fever of turberculosis may be classified into 6 groups.

1*st Type.* The temperature in the morning is normal or at any rate below 99 degrees. In the evening it rises to 99°—100°. This is the common type in the earlier stages. The patient is unaware of the fever and only complains of dyspepsia or lassitude especially in the evenings. This stage is commonly missed by the general practitioners. The patient laughs at the idea of fever and is ready with an explanation for the slight rise. The patients in this condition are accidentally discovered to be tuberculous. They come in complaining of dry cough, anorexia, or lassitude or heat. I don't argue with this class of patients but send them home and ask them to take rest and record their temperature every 4 hours for a few days. When these patients come to me again with their temperature records, they are easily convinced, that they are really suffering from a low fever. In these cases the tuberculin tests are particularly valuable. If the tuberculin tests be positive, and the temperature be sub-febrile the case should be considered as tuberculous (unless we can account for the fever in any other way) though physical signs pointing to the location of the tubercular lesion may be wanting.

When there are only a few scattered tubercles say in the lungs, we cannot possibly expect any definite signs. The scattered tubercles when few in number, (In an early stage of the disease they *must be few and must be small*) are too small to produce physical signs ; but they are big enough to produce a few milligrammes of tuberculin, to poison the system and produce slight constitutional symptoms.

According to Birsch Hirschfeld, Pulmonary tuberculosis most often begins as a local deposit in the mucous membrane of the medium sized bronchi. The lesion is localised, by preference, in the posterior half of the apex of the lung (more often in the right than in the left) and in the part of the upper lobe lying immediately over this. The swelling of the mucous membrane and the narrowing of the lumen of the bronchus, lead to obliteration of the bronchi ; then follow collapse and shrinking of the distal smaller bronchial tubes producing the early signs, of impaired resonance, increased fremitus, impaired movement, altered breath sounds &c. See Figs. XXVII & XXVIII for this type of temperature.

2nd Type. This type is characterised by a distinctly subnormal morning temperature (96° to 97°) and an evening temperature differing from the minimum by 1½ degrees to 2 degrees F. The evening temperature may be near 99°. This kind of temperature is highly suspicious of tubercle. It indicates smouldering mischief. The class of patients in whom you find this temperature, complain of lassitude and general debility far more than any other class of tubercular patients. They are unable to do even light work and get very easily tired. No stimulant does them any good and no tonics improve them. Their weariness seems to be in the very marrow of their bones. They seem to eat fairly well and their digestion is good. Some of them complain of sleepless nights. Most of them like to lounge in their beds or chairs. But they can't help working to earn their bread or to study for some examinations. In this class of patients also when the tuberculin tests are positive, the cases should be diagnosed as tuberculosis and treated as such (by auto-inoculation and fresh air, or tuberculin injections).

If we are satisfied with the presence of tubercular lesions in the body, it does not matter where they are. The treatment is. the same wherever the lesion might be, sanatorium, or tuberculin or sanatorium and tuberculin treatments.

If we wait for the development of definite signs for our own satisfaction, the disease will progress ; and the patient will be in a less satisfactory condition for treatment. Our mental satisfaction in diagnosis is inversely proportional to the chances of cure for the patient. See Figs. XXIX, XXX & XXXI.

3rd Type. This type is characterised by a subfebrile temperature or sometimes a normal temperature in the morning and an afternoon rise to 101 degrees and over with chills and pain all over the body, head-ache and other signs of fever. Patients who belong to this class know they are ill and consult medical men. Very often they show distinct physical signs and may or may not expectorate (open or closed tuberculosis). The lung condition is that of stage II of Turban. The lungs do show signs of breaking down. This is the type very frequently mistaken for malarial fever by medical men who are satisfied with the daily regular repetition of the chills and high fever in the evenings. As the temperature is subfebrile in the mornings, the patients tell their medical advisers that they have no fever in the mornings, and the medical advisers are satisfied that the cases are really malarial and dose their patients with quinine. If in addition to the broncho- pneumonic condition of the lungs, pleurisy be also present, the spleen and the liver will naturally be pushed downwards and such displacement will enable the physicians to feel the spleen or the liver or both the organs below the costal arch. As the physicians are already prejudiced in favour of malaria, such displacement will strongly confirm the diagnosis of malaria. An examination of the blood before the administration of quinine would certainly reveal the presence or absence of malaria. The tuberculin tests the careful examination of the chest, and the observations of the temperature in the mornings, will certainly reveal the presence of tuberculosis. I don't deny the possibility of the co-existence of malaria with tubercle. But I contend that the diagnosis of malaria must be based on the discovery of malarial parasites and that the presence of the parasites does not necessarily exclude tuberculosis. The cough in these cases, really due to tuberculosis, is attributed to the congestion of the throat or bronchitis. As in 70 % of the cases of tuberculosis, granular pharyngitis or enlargement of the tonsils, or both, are to be met with, even the cough does not put the unwary observer on the guard.

There is no drug that is more misused in this country than quinine. Nothing is lost by waiting for a few days and making the diagnosis of *malaria certain* before administering quinine. There should be no difficulty throughout this Presidency in sending a specimen of blood either to the district head-quarters or to the King Institute to get an opinion as to the presence or absence of malarial parasites.

By mistaking the diagnosis in the cases belonging to this type, the (*the malarial type*) physicians will do enormous harm to the patient who will rapidly lose what little appetite he has, and rapidly pass on to the hopeless stage 111 of Turban and become a menace to society. These cases require urgent treatment at a sanatorium, if the temperature is not lowered by rest in bed, till, the temperature is lowered, and subsequent injections with tuberculin. See Figs. XXXII & XXXIII.

4th type is characterised by continuously high temperature throughout the day. These are practically advancing and hopeless cases. See Fig. XXXIV.

5th type. The hectic type, corresponding to the septic type of the general (surgeon). This type is sufficiently familiar to all physicians with its low morning temperature and the high evening temperature with chills and sweats. See Figs. XXXV & XXXVI.

These last two types are very satisfactory to the physicians who want an exact diagnosis, as to the seat of trouble and the extent of mischief in the lungs. These are the cases of tuberculosis seen by the Hospital physicians in this country. And these are the cases that make the European medical men think, that tuberculosis runs a very rapid course in this country.

6th type. This type is characterised by a morning rise and an evening fall. It is known as the inverse type. It is hopeless. The prognosis is very bad. I have had only one case of this type under my care. Another case in the mofussil, which was referred for my opinion had a temperature of this type. I dissuaded the friends from bringing the patient to Madras, as such a type is said to be of very bad prognosis. The patient died within a month from the date of reference to me.

I have already stated that the study of the temperature chart is of great help in the diagnosis of early cases. The temperature chart and the symptoms, are of far greater importance than the physical signs. If the chart shows a daily rise, however small, which cannot be accounted for, or a very subnormal temperature, I am inclined to consider the case as tubercular until the contrary is proved. Under these circumstances the tuberculin tests are of very great value. The opsonic test has also been declared to be of great help. I have no personal experience of it and my study of the literature of the subject has not convinced me of the utility of the opsonic test in diagnosis or treatment. The tuberculin tests are of considerable value in helping us to arrive at a correct and early diagnosis of tuberculosis. Many kinds of tuberculin tests have been used by different observers from time to time. But I consider only 3 of them to be most serviceable, *viz.*—

Von Pirquet's, Cutaneous test—
Calmette's, Conjunctival test—
Koch's Sub-cutaneous test.

Of these the cutaneous test is the simplest and the most popular. It is known also as Von Pirquet's test. It consists in scarifying with the point of a lancet the skin of the forearm (any part of the body will do quite as well) in 2 places through a drop of 20-25% tuberculin. It is usual to scarify a third spot also through a drop of sterile salt solution or weak glycerine and carbolic lotion. This third spot is for the purposes of control. If the re-action be positive a certain amount of induration and redness (varying in size from $\frac{1}{4}''$—$2''$ in diameter) will be seen around the spots, where tuberculin was placed, while there will be no inflammation around the control spot. The induration and redness can be seen in 5 or 6 hours if the re-action be severe, and in 24 hours in all cases. The inflammation increases in severity for 48 hours and is at its height after 48 hours. In a few cases the inflammation is so severe as to cause ulceration. I have seen such a severe re-action only in scrofulous cases and in cases of tuberculosis of the kidneys. Such severe re action leading to ulceration is more likely to be present if we use undiluted tuberculin as directed by Wolff Eisner. Wolff Eisner is of opinion that if one test with 25% tuberculin be negative, a 2nd test should be done with the undiluted tuberculin. The test with undiluted tuberculin is extremely delicate. It is said to give a positive re-action even in healthy individuals, I have myself seen a positive re-action in 4 *apparently* healthy individuals. But I don't consider such a re-action as a defect in the test. All I can say is that, in such *apparently healthy* individuals there is no *active* tubercular lesion. Most probably such individuals will have healed up foci. With undiluted tuberculin, I have failed to get a re-action in many healthy individuals. If we want to exclude *tuberculosis definitely* it is better to use undiluted tuberculin. I make the dilution with sterile salt solution and on the day on which the test is to be carried out. After 48 hours (sometimes 24) the solution is likely to be spoiled even in sterile test tubes.

Strict-asepsis must be observed in carrying out the test. I made some observations on the simultaneous use of human tuberculin and bovine tuberculin in carrying out this test (using human for one spot and bovine for the other spot) to see whether we can get any evidence as to the nature of the bacilli present in the system human or bovine. But I found that when one variety of the tuberculin gave a re-action, the other also did. Therefore we may be satisfied with the use of human tuberculin alone.

The value ot this re-action is very great in children under 12. At any age a negative cutaneous re-action would greatly negative the supposition of tuberculosis. The test may fail in cases when there is not much vitality in the system and also in some early cases. On the whole I consider the test as a very valuable aid though not absolutely infallible. I have done nearly 600 tests and I find that there was reason to doubt its accuracy in less than 3% of them. Von Pirquet has noted that the percentage of cutaneous re-action corresponds very closely to the post-mortem statistics especially in children.

The positive re-action in the culaneous test only indicates that the system has been infected with the tubercle bacilli. It does not necessarily indicate an active lesion, unlike the conjunctival test which is said to indicate an active lesion.

The conjunctival test (also known as the opthalmic test, Calmette's test and Wolff Eisner's test) consists in the instillation into the conjunctival sac, of a drop of $\frac{1}{2}$%—1% solution of tuberculin in sterile normal salt solution. A positive re-action would be indicated by a redness of the palpebral conjunctiva. The re-action commences in 5 to 12 hours as a rule. In some cases the re-action is delayed. In 3 cases I saw a re-action only after 48 hours. It the re-action be severe, there may be a severe inflammation of the conjunctiva. I have tested about 500 cases and have never met with any untoward results. Only in one case I found very severe inflammation of the eye with chemosis but no damage occurred to the eye. In two cases I found the re-action persisting for many weeks. Many of the medical officers are very much afraid of this test. I think the dread is unjustifiable, if fresh sterile solution be used and if care be taken to see before instillation *that the eye is healthy.*

The men who object to the use of this test as dangerous are just the men who have no personal experience of it.

Wolff Eisner basing his observations on his own experience and on about 10,000 reported cases has made the statement that there are few unfavourable symptoms.

Calmette basing his observations on 1000 instillations by himself and many thousands of instillation by other observers came to the following conclusions :—

"The test is not dangerous, but precautions must be taken to see that the eye is healthy and that the tuberculin is aseptic and pure. Only in 80 cases out of 20,000 (or 0·4%) the re-action was severe, so that there was less danger in this procedure than in the exposure to X rays or the puncture of a vein)."

The significance of the conjunctival test is very great.

My own experience based on about 500 observations, is in entire accord with Calmette's statement.

The conjunctival reaction indicates the presence of active tubercular foci. It is apt to be very severe in scrofulous cases. In patients with enlarged lymphatic glands about the neck, it would be necessary to use a half per cent. instead of a 1 % solution or dispense with the test altogether.

I consider both these tests extremely valuable in the diagnosis of tubercle. If in an apparently healthy man the conjunctival test be positive it is necessary to examine all the systems very thoroughly and observe the temperature for a fortnight under varying conditions. If the temperature be normal Koch test should be applied without hesitation before he is declared free from a tubercular taint.

I am in the habit of using both tests at the same time so as to save time. Moreover I don't like to have a small amount of tuberculin (however infinitesimally small) circulating in the body at the time, the next test is applied. Personally I am not fond of repeating these tests. If these tests fail, I like to use Koch's test, if there be no contra-indications. But if there be any contra-indications, the test might be repeated after a fortnight.

The value of Pirquet's test (even when Calmette's test is negative) is shown by the following case :—

Case 102. A young man complaining of anæmia and weakness. There was dullness above and below the right clavicle and pain and bronchial breathing about the superior angle of the right scapula. The cutaneous test was positive, but the conjunctival test was negative. I thought it possible that I might have missed a fleeting conjunctival reaction occurring during the night. So Koch's test was applied. The very first injection was accompanied by swelling and pain around the point of injection and a rise of temperature. A repetition of the same dose raised the temperature still higher. See Fig. XLVIII.

The application of these two tests simultaneously has sometimes the effect of diminishing the temperature and improving the condition of the patient, as is seen in the following cases. See Figs. XXXVII, XXXVIII & XLI.

Case 40. The tests brought down the temperature in a fortnight to the normal and the temperature was normal, for a fortnight. This tempted the attending physician to give tuberculin injections which made the patient get worse and worse quickly. The patient had to be discharged. See Fig. XLI.

Sometime back there was a case of turbercular laryngitis in one of the medical wards in the General Hospital. The acting physician in charge of the case desired to see the tests done on the patient. The tests were applied and proved positive. The patient noticing an improvement in his condition subsequent to the application of the test, thought that the application of the test was a new kind of treatment. When I entered the same ward sometime later, to apply the test on another patient, this laryngitis patient requested me to repeat the treatment, as he found that the previous dose had done him a lot of good. I did not accede to his request (though I was of opinion that small doses would certainly have improved him) as the medical officer was not very keen about it, though I suggested tuberculin injections. Two months later, the permanent physician returned from leave and took charge of the ward. He in turn desired to see the effect of the tuberculin tests. As the laryngitis patient was still in the ward, I caught hold of him for the demonstration and applied the tests again. The patient was of course delighted at having the 2nd dose. Just as the patient expected, there was an amelioration in his condition—a feeling of well being and less hoarseness of the voice. Both the tests were positive again.

In other instances the temperature is raised for the time being for one or two days. Subsequently there is a fall to the preceding height or to the normal. See Figs. XXXIX & XL.

Koch's sub-cutaneous test is extremely valuable as it enables us not only to detect the presence of tuberculosis but also the site of the disease. It is a test that should be used only under puzzling conditions, and when there is no fever and when there are no contra-indications. When the diagnosis is sufficiently clear and when bacilli are found in the sputum, it should not be used. Its use, except in the hands, of careful and experienced observers, is likely to be attended with certain possibilities of danger. The view at the present day is that the tuberculin in carefully graduated doses in skilled hands is entirely harmless, danger only resulting from its indiscriminate and careless administration. It has been pointed out by some that the reaction may be obtained in apparently healthy individuals. But in such cases latent lesions are likely to be present. The test when positive, brings about a general reaction marked by fever and other constitutional disturbances, swelling, redness, and pain around the injected part, a local reaction at the seat of the disease, marked by well defined physical signs and increased severity of the symptoms complained of, by the patient. As the rise of temperature is one of the important signs looked for, the test is not applicable to febrile cases. If the maximum temperature exceed 99·5, the test is inapplicable. But if the temperature can be brought down by rest in bed for a week or two, the test may then be applied. The application of this test necessitates a two hourly record of the temperature for a few days before the test, and during the test. A rise of temperature of at least 0·5 F above the previous maximum is taken as positive.

The contra indications to the test are, a temperature above 99·8 degrees in the mouth (some accept 99·5 degrees), a certain diagnosis on other grounds, extensive physical signs, hæmoptysis, night sweats or great dyspnea, heart disease, renal disease, epilepsy, hysteria, general glandular involvement, meningitis, suspected miliary tuberculosis, intestinal tuberculosis and suspected intestinal ulcers, convalescence and weakness immediately after diseases like typhoid, pneumonia and diabetes, tendency to apoplexy, marked arteriosclerosis, and amyloid degeneration of the abdominal viscera.

I use this test only as a last resort when the other tests and the usual clinical methods of investigation fail. The test consists in the sub-cutaneous injection of tuberculin in increasing doses (up to 10 m. gm), in the upper arm. The test solution must be made on the day of injection, with sterile salt solution. The first dose is 1/5 m. gm. The succeeding doses are 1,5, and 10 m.gm. In the case of weak people and women the initial dose is 1/10 m.gm. In women the inter-menstrual periods should be chosen. For children proportionally smaller doses are recommended. But in children I consider Von Pirquet's test quite sufficient and satisfactory. In children the doses are 1/10, 5/10, 1 & 3 m. gm. Lowenstein advocates the use of 1/5, 1/5, 1/5, 1/5 and then 2, 5, 10 m. gm. He aims at producing hypersusceptibility by repeated small doses. It is usual to leave an interval of 2 days (some leave 3 days) between the doses. But as the reaction is not likely to occur after 48 hours I often leave an interval of one day between the injections and repeat the injections after 48 hours. I will give a few examples to illustrate the value of this Koch's test.

Case 72. A young man aged 28, an electrician was admitted into the hospital for blood spitting. The temperature was normal and there were no physical signs pointing to disease of the lungst The medical officer suspected tuberculosis of the lungs and sen. the man over for the tuberculin test. I found both the conjunctival test and the skin test negative. But the medical officer was not satisfied and wanted to have the test repeated in a week

Both tests (on the other eye and arm) were negative again. But as the medical officer was not convinced that it was not a case of tuberculosis, I submitted the young man later on to Koch's test. But the Koch's test was entirely negative as might be seen from the accompanying figure, and I was able to assure the young man that he was not suffering from pulmonary tuberculosis. Some months later I learnt from another patient who was working in the same electric laboratory that this young man was in the habit of inhaling strong acid fumes day after day, The corrosive action of the fumes must have had something to do with the staining of the mucus with blood. See Fig. XLII.

Case 104. A young girl of 18 was sent over, for diagnosis by a mofussil medical practitioner. The patient happened to have a slight rise of temperature on two occasions. She was seen by the mofussil doctor who detected dullness at the apices of the lungs. Both the mofussil doctor and myself expected the tuberculin tests to be positive. But as the conjunctival and the cutaneous tests were negative, Koch's sub-cutaneous test was applied. As Koch's test was negative, I had to conclude that there were no active tubercular lesions and that the physical signs pointed to old healed up lesions. I hear she is doing well. See Fig. XLIII.

Case 103. A young girl aged 18. Her husband was suffering from tuberculosis of the lungs in an early stage. He had also various troubles in his nose, pharynx and nasopharynx. He thought that his wife who had been coughing for some time, might probably also be tuberculous. As the conjunctival and the cutaneous tests were negative, Koch's test was applied and found negative. She was declared free from tubercular taint and sent over to the Surgeon for further investigation. In both these cases I was prejudiced in favour of a diagnosis of tuberculosis. But my suspicions were not confirmed by Koch's test. There was not even a local re-action at the site of injection. The patient is doing well. See Fig. XLIV.

Case 71. A medical student who was suspected to have tubercular pleurisy by a fellow practitioner. Both the conjunctival and the cutaneous tests were negative. As his temperature rose to 99 degrees in the evening and fell down to 97 and below in the morning, his condition was suspicious and he was therefore submitted to Koch's test, Koch's test proved positive. See Fig. XLV.

Case 38. A young clerk from the mofussil who came with cough and fever. He was supposed to have asthma. He had granular pharyngitis. The cough was troublesome. There was asthmatic wheezing, and fine crepitations were heard all over the back. Near the superior angle of the left scapula there was a patch of dullness where vocal resonance and vocal fremitus were distinctly increased. In the front below the left clavicle, roughened breathing was present. These physical signs and the continuous ow fever made me think the patient had something more than asthma. The conjunctival test and the cutaneous tests were applied and found negative. On repeating them after 10 days they were negative again. Therefore Koch's test was applied. The result is seen in the chart. After the 3rd injection there was a considerable rise in temperature, difficulty in breathing, malaise, pain over the dull patch in the back, increased cough and local swelling at the seat of injection. He was subsequently treated with tuberculin injections for 5 months and was discharged cured of his fever, asthma and cough. See Fig. XLVI.

Case 73.—A young man from the mofussil complaining of cough, fever, anorexia and loss of weight. He gave a history of cough for nearly 18 months. Dullness, increased vocal resonance, and increased vocal fremitus were made out along the whole vertebral border of the right scapula and about the superior angle of the left scapula. Along the vertebral border of the left scapula were heard fine crepitations and occasional squeaking sounds during inspirations. The breath sounds on the right side of the back were accompanied by peculiar musical sounds. The sputum had been previously examined by a medical man with negative results. I was not able to detect tubercle bacilli on the first occasion. But on a 2nd occassion I found a single acid fast bacillus. The cutaneous and conjunctival tests were negative. Therefore I applied Koch's test. After the second injection the cough increased, and after the third injection the cough became very severe and the sputum increased in quantity and blood was found in the vomit after a severe cough. There was a rise of temperature accompanied by headache. And the physical signs were more marked. The dullness, and the increased vocal resonance noted above, became more marked. Near the lower angle of the left scapula was detected another patch of dullness where fine crepitations could be heard. All over the right back were to be heard moist rales with occasional clicks. The breathing was bronchial on both sides over the dull patches. In the front above and below the clavicles dullness was noted. Clicks can be heard at the end of the inspirations on the left side. See Fig. XLVII.

Case 48.—Another highly interesting case. This was a young boy with slight fever, difficulty in breathing and enlarged liver and spleen. The spleen extended 3 fingers' breadth below the ribs and the liver one finger's breadth below the ribs. At the base of the right lung (back) was slight dullness. Some dullness was made out between the root of the spine of the right scapula and the vertebral column. Beyond this nothing could be found. The temperature ranged from 99 to 100·4. The boy appeared puny and ill-developed. The penis and the testicles were ill-developed. (This boy had consulted me about 3 years previously, as the development of his body was not proportionate to his age. On that occasion I had asked him to go over for a change and use cod liver oil, as he had no fever and no symptoms pointing to any affection of the lungs. I applied both the conjunctival and the cutaneous tests. But both were negative. A week later I repeated the tests which were negative again. The blood was examined for malarial parasites and Leishman Donovan bodies. But no parasites could be found. Col. Donovan examined the boy and his blood, and he arrived at the conclusion that it was neither malaria nor kala-azar. Santonine was administered but no worms were expelled. As malaria and kala-azar were excluded and as I could not properly account for the slight rise of temperature I submitted the boy to Koch's test. There was a slight rise of temperature after the third injection but as the physical signs were not conclusive, I broke the rule of not increasing the dose when there is a distinct rise however small and passed on to the next dose. The result was a reaction of extraordinary severity lasting for 4 days. The fever was high and accompanied by severe headache, pain all overl the body, pain round the navel, pain over the spleen and the liver, pain in the right iliac region, and a severe attack of dysentery. There were 4 loose motions on the first day and there were twelve bloody stools with mucus on the 2nd day. The pulse was 130 and the respiration 38. The breathing was bronchial between the scapulæ and below the right clavicle. The dullness in the base of the right lung was marked and the respiratory sounds were feeble over this spot. On the third day hiccup set in but was easily controlled; and on the fourth day the temperature come down with profuse perspiration. On the sixth day the temperature became perfectly normal and the boy was relieved of his sufferings. His temperature subsequently was subfebrile. As I did not like to submit the boy to any treatment by injections I sent him over to Trichinopoly for a long holiday and asked him to be in the open air as much as possible and feed himself well. The boy picked up flesh but the temperature was very unstable and rose from time to time to 100-101 degrees. Subsequently after carrying out the open air treatment for 7 months as best as he could, he returned to me for the injections. To carry out the open air treatment, I had provided him with Hyslop Thompson's Home treatment of consumption, an excellent little book which I recommend to every one of my patients. The boy carried out the directions conscientiously and returned 12 lbs. heavier; and his liver and spleen had become reduced though still larger than normal. But his temperature was still very unstable and so was treated with tuberculin injections for 5 months. He was discharged cured. His liver and spleen had become normal. He had got stouter and weighed III lbs. (not bad for his age 18 years). His body though short was strong. He was able to take exercise without rise of temperature and his penis and testicles had developed well and I removed my veto on his marriage. The interesting features in this case were:—

1. The possibility of enlargement of the liver and the spleen being due to tuberculosis. (For some time past I have been under the

impression that the enlargement of the liver and the spleen found in young children in the southern districts and attributed by the Indian mothers to the use of cow's milk, is due to tuberculosis. To test the accuracy of this view I tested 4 children affected with such enlargement with Pirquet's cutaneous test and found the reaction positive. It is a subject that requires further study and attention. And I hope to study the subject in the near future. Such study is intimately connected with many important questions, viz. the presence of bovine tuberculosis in this country, the presence of abdominal tuberculosis in children, the relation between the bovine and the human forms of tuberculosis &c.

Before passing on to prognosis, I may point out that some Phthisio-therapists attach some importance to the examination of the chest by the X rays for the detection of early cases. But I find from my study of the literature, that the X ray examination only confirms the physical findings made by a competent physician and that it does not afford any help in those cases where physical signs are entirely wanting. The X ray examination can in no way compete with the tuberculin tests in the early diagnosis of pulmonary tuberculosis.

In the majority of my female patients, I find that there is some tenderness over the appendix and sometimes over one or both ovaries. In two cases there was unmistakeable appendicitis (diagnosed independently by other medical practitioners) which disappeared under the tuberculin injections.

Twenty to thirty years ago the diagnosis of tuberculosis of the lungs was equal to a death sentence. But in succeeding years it was held that death could be delayed in specially favourable climatic surroundings. In still more recent times it has been held that tuberculosis is an easily curable disease if taken in hand early. Even in the later stages it is believed that much can be done to arrest the disease and to postpone death if properly treated, unless the disease has advanced considerably and damaged a very large portion of the lungs.

The success of the treatment depends partly on the extent and the amount of damage to the lung and partly on the general condition of the patient. The amount of mischief present in the lungs can be roughly expressed by classifying the cases under three classes as pointed out by Turban (of Davos). Most of the phthisio therapists of the world accept this classification with little or no modification.

The following classification is given by Turban.

Stage I. Disease of slight severity, affecting at most one lobe or two half lobes. Little or no expectoration. Often no bacilli in the sputum,

Stage II. Disease of slight severity, more extensive than in stage I but affecting at most one lobe.

Stage III. All cases of greater extent and severity than in stage II. By disease of "slight severity" is to be understood :— disseminatad foci manifested clinically by slight impairment of resonance, rough or weak breathing, with fine or medium rales.

By severe "disease" compact consolidation and cavities recognized by dullness, tympantic note, bronchial or amphoric breathing with medium or coarse rales.

Camac Wilkinson interpolates a stage I-II between I and II and II-III between II and III. Of these I-II is a useful addition.

In stage I, the physical signs are limited to the apex of the lung and do not extend below the clavicles in front and the spine of the scapula at the back.

In stage I-II the physical signs extend as far as the 2nd rib.

In stage II, the physical signs extend below the 2nd rib.

To this we might add a stage O, in which no physical signs can be definitely made out.

This classification is mainly pathological but very convenient to describe, record and compare the condition of the lungs in the different patients.

But for purposes of treatment Dr. Inmam's classification (into Ambulant afebrile, Resting afebrile, Resting febrile) is useful.

Each one of Turban's stages may be sub-divided into these 3 classes.

Complete recovery is possible only in stages O, I, and I-II,

In stage II the disease may be arrested.

But in stage III the prognosis must always be bad.

The prognosis depends far more on the constitutional symptoms than on the actual amount of the lung tissue damaged. The ancient Sanskrit writer Charaka (who flourished in 1st century A. D.) advised medical men who cared for their reputation, not to treat cases where the constitutional symptoms were exceptionally severe. His view is still correct.

A persistently high temperature (101° and over, day after day) indicates very active extension of the disease and must be regarded as of serious import. In hectic fever the prognosis must be considered very bad.

If the high temperature can be brought down to 99·5 by rest in bed, the prognosis may be more hopeful.

Next in importance to the temperature, as a factor in prognosis, comes digestion. A good stomach is the most valuable asset to a consumptive. I have had no trouble with patients who had good digestive powers. A good digestion, a cheerful disposition, and perseverance in carrying out the instructions of the doctor, play an important part in the recovery from the disease. Pregnancy, hæmoptysis and a poor digestion are the 3 factors I dread most.

If rest in bed in open air fails to bring down the fever, the prognosis must be considered bad. Frequent attacks of hæmoptysis will result in the extension of the tuberculous process as might be seen from the accompanying chart. (Fig. 49).

Each attack of Hæmoptysis is followed by a rise of temperature which is an indication of the extension of the lesion.

Tuberculosis in pregnant women is always a cause for anxiety. The pregnancy itself does not exert much influence on the course of the disease. But the effects of parturition are to be regraded as serious. The disastrous effects of parturition are best illustrated by in the chart (fig. 50).

The prolonged muscular exertion, with a loss of blood, the attendant exhaustion, the inhalation of infectious material during the pains may all contribute towards an aggravation of the disease.

Case 34.—Young women of twenty, in her third pregnancy.

As rest in bed did not succeed in reducing the temperature a series of anti-strepto coccus serum injections were given. The beneficial results on the temperature, resulting from the third injection of anti-strepto coccus serum are well seen in the chart. To keep up the effect, a fourth injection of the serum was given. But within 4 days, labour set in and increased the severity of the disease. From the very day of labour the temperature rose high and never came down to the normal even once in a day (as it used to do before). The subsequent course was a rapid extension of the disease ending in death.

I have notes of 6 other cases of tuberculosis in women, in whom the disease began to make rapid progress after a labour or an abortion. But they all survived the first two pregnancies. Dubois' dictum, quoted by Osler with approval, that a tuberculous woman will survive her first pregnancy and may survive the second pregnancy too, but will never survive the third pregnancy has been found only too true in my practice.

Multiple pregnancies even in cured patients are dangerous. Female patients living with their husbands always give me considerable anxiety. It is highly desirable that tuberculous women should be sterilised by ligature of the fallopian tubes to guard against pregnancy.

The modern treatment of consumption dates from the establishment in 1859 of the sanatorium at Gorbersdorf in Silesia by Doctor Brehmer, who emphasised the importance of open air, methodical exercise, an abundant dietary and unremitting medical supervision. (Boddington in England had advocated in 1840 the importance of open air). Doctor Dettweiler, his pupil, laid more stress on persistent rest in the open air, than on graduated exercise in his sanatorium started in 1876 at Falkenstein near Frankfort.

In 1888 Doctor Otto Walther established the famous Sanatorium at Nordrach in the Black Forest and combined the principles of Brehmer and Dettweiler. He strictly insists upon rest as long as the fever lasts, and insists on a prescribed amount of exercise later on.

A life in the open air, the regulation of rest and exercise, according to temperature, circulation, strength, body weight, digestion and lung condition and an abundance of food are the essentials of the treatment.

The sanatorium movement has spread to all parts of the world at present. It was formerly held that sanatoria could be successfully established only in forests and mountains in particular climates. But recent experience all over the world has proved that sanatoria can be successfully worked in any climate.

The essential factors in the sanatorium treatment, or the open air treatment, are life in open air, regulation of exercise and rest, careful feeding and medical supervision. And these can be had anywhere.

In 1890 Koch announced the discovery of tuberculin and recommended its use for curative purposes. It was injected, at first, rashly into all sorts of cases and led to disastrous results. The use of tuberculin subsequently fell into disrepute. This verdict was not justifiable, for a large proportion of the harmful effects ascribed to tuberculin were in reality due to the fact, that Koch's directions were not correctly carried out and followed.

The causes of failure were

1. Its use in unsuitable cases ;
2. Its use in too large doses ;
3. Its use when the temparature was abnormal ;
4. The failure to diminish the dose when there was a rise of temperature. Koch later on, introduced other forms of tuberculin, the new tuberculin—T. R. and B. E. Thanks to the work of Trudeau in America ; and Spengler, Petruschky, Krause, Goetsch, Neisser and others in Germany, the details of administration have been carefully worked out. At the present day tuberculin as a remedy is appraised at its proper value.

At first the sanatoria people were opposed to the use of tuberculin. But in recent years many sanatorium superintendents have taken to the use of tuberculin.

In Germany in 1911, 75 per cent, of the sanatoria were using tuberculin (according to the reports of the German Central Committee for the campaign against tuberculosis).

Ritter in charge of the Edmundstall sanatorium, who had an aversion to the use of tuberculin, selected, for the administration of tuberculin, cases that had been refused admission at public sanatoria and cases that had been previously treated without benefit. And the results of the treatment of these cases were so satisfactory as to make him a firm adherent of the tuberculin therapy. He sent in a communication to the Deutch. Med. Wochenschrift in 1908, stating that sanatorium physicians were not merely justified, but in a certain sense bound, to make the widest possible use of tuberculin in the treatment of pulmonary tuberculosis. Moeller of the Belzig sanatorium near Berlin, a recognised authority on tuberculosis, at first an utter sceptic of tuberculin treatment, later on, became one of its most earnest advocates.

Trudeau's studies have popularised the use of tuberculin in America. In England and Australia, under the advocacy of Camac Wilkinson, tuberculin is coming into larger and larger use. The value of the open air treatment was first pointed out by an English man and it is essentially an English discovery. But England refused to profit by the discovery, till the Germans Brehmer, Detteweiler and Walther worked out the details and established the new method of treatment on a firm foundation. Even after acknowledging the value of the sanatorium treatment, England sent her consumptives to the sanatoria in Germany and Switzerland.

Sanatoria were established in England only during recent times. Doctor Philip of Edinburgh first proved the possibility of successfully treating Pulmonary tuberculosis at home sanatoria, and the possibility of dispensing with the Swiss mountains and the German Forests.

Immediately after the discovery of tuberculin by Koch, the British Physicians made a rash use of tuberculin without regard to the conditions laid down by the great discoverer and came to grief. For a second time Germany had to carefully work out the details of a far more efficacious method of treatment and proclaimed to the world the vast superiority of a combined method of treatment (tuberculin and sanatorium treatment) to the simple method of sanatorium treatment.

As England recognised the sanatorium treatment as a settled fact only in the past few years, she is puzzled when approached with another settled fact. Wilkinson, a pupil of the German discoverer has been recently dinning into the years of England, that she must accept the new method of treatment both on humanitarian and on economic grounds. The tuberculin league in England has been successful, in increasing gradually the number of tuberculin dispensaries in England.

There are many varieties of tuberculins in the market and different Phthisio therapists have been using different preparations. But as all the men who have been using tuberculin in recent years, claim to have got satisfactory results, it may be assumed that most of them (if not all) have a similar action.

From personal experience I find that the old tuberculins are more powerful than the new tuberculins and that tuberculin T. R. is the safest preparation on the whole, and particularly in inexperienced hands. B. E. is not so safe to handle, but it is cheaper than T. R. I prefer the T. R. Mixed, conveniently put up in azoules by Allen & Hanburys.

It is impossible to lay down hard and fast rules as regards the minimum dose, the rate of increase, the length of interval and the maximum dose. They have to be judged by the condition of the patient, the temperature, the extent of the affection, the amount of response, both local and constitutional to the injection, the amount of exercise permitted to the patient etc. I will now describe some illustrative cases to show the value of tuberculin.

Case 2 (see figure 51) a young woman of 32 years.
Family History bad. (One brother had died of tuberculosis, one cousin brother reacted positive to Calmette's conjunctival test. Husband was suffering from diabetes and Pulmonary tuberculosis.) She complained of diarrhœa, fever, anorexia, emaciation and weakness. There were no definite physical signs in the lungs. She had

to be brought to my house in a carriage. The conjunctival test was positive and very severe. She was put on peptonised milk and ordered to take to her bed. In a week the diarrhœa disappeared. And in 20 days the maximum temperature came down below 100 (ranging from 99·3 to 99·8). As soon as the temperature improved 1-5,000 m. gm. B. E. was given by the mouth on an empty stomach. The result was a rise of temperature to 102 degrees on the next day and the reaction lasted 4 days as might be seen in the accompanying chart. On the 8th day 1-5,000 m. gm. B. E. was given by the mouth again ; the result being the occurrence of a reaction on the next day and which lasted two days *i. e.* less than on the previous occasion. After another 8 days tuberculin 1-200,000 m. gm. B. E. was injected hypodermically. She had put on 7½ lbs. in weight by that time. Injections were continued till she got 1-2000 m. gm. She had to be discharged after 13 injections, as her domestic circumstances necessitated her immediate departure from Madras. She was 3½ months under treatment and the maximum dose in her case was 1-2,000 m. gm. B. E. When discharged she had neither fever nor diarrhœa. Her appetite was very good. And she was able to take fairly long walks and had increased in weight from 69½ lbs. on admission, to 97lbs. on discharge. On enquiry I find that she has had no relapse up to date (nearly 3 years since discharge.)

Case I was very similar to this. I am unable to give the details as the charts have been lost. In that case the oral administration of tuberculin T. R. (Allenbury) 1-1000 m. gm. gave rise to a reaction lasting for 4 days on 3 successive occasions.

Case 4. A young girl of 16 years. Father suffering from tubercular dyspepsia. She was stated to have suffered from malaria. But her emaciation and low fever suggested pulmonary tuberculosis. The tuberculin test, cutaneous and conjunctival, were both positive. She complained of anorexia, emaciation, low fever, amenorrhea and dysmenorhea. Her ovaries were enlarged and tender. At the apex of the right lung the respiratory sounds were rough. Vocal resonance and vocal fremitus were both increased. The gynœcologist ordered rest and hot douches with iodine for the inflamed ovaries. The gynœcologist agreed with me in suspecting the right apex. The local treatment did not do much good but the dysmenorrhœa and the ovarian inflammation subsequently improved under the injections. This girl was able to stand 7½ m. gm. tuberculin B. E. well and the temperature on discharge at the end of the 1st course was 98° in the morning and 99° in the evening. As she became pregnant after discharge she was submitted to a short 2nd course. During the later months of pregnancy she had an attack of troublesome cough. The only lung signs were moist rales all over the chest; an expectorant mixture I prescribed, seemed to have had no effect. The girl was shown to another practitioner who put her on glycoheroin which stopped the cough but had absolutely no effect on the rales in the chest. When the father showed me the girl again, I suggested a few more injections. And just as I expected, half a dozen injections of tuberculin made the rales completely disappear. Later on she was confined of a healthy child. See Fig. 52.

Case 5. A young lady of 33 years complaining of cough and poor digestion. Tubercle bacilli were not found in the sputum on the first two occasions. On the 3rd occasion only two bacilli were found in a whole slide. Col. Giffard detected a few moist rales at the apices. The lady was put on a long course of injections for about a year. Col. Giffard examined her again at the end of the course and could find no sign of disease in the lungs. Although she was of a weak constitution she stood 7½ m. gm. B.E. tuberculin very well. The appetite improved and the cough disappeared. On one occasion the injection caused a sterile abcess which did not give any trouble.

Case 6. A young man of 28, Forest Ranger by profession. He came with a history of fever, anorexia, diarrhœa, dyspnea on exertion and emaciation. He was very anemic. His temperature was sub febrile in the evenings going up to 99·6-99·8 degrees. On the right side of the back, along the whole length of the scapula between the spine and the scapula the percussion note was distinctly dull and vocal fremitus and vocal resonance were increased. The respiratory sounds were of the cog-wheel type. The tuberculin tests, cutaneous and conjunctival were positive. He was subjected to the tuberculin injections for eight months. Under the injections he improved so rapidly that he was able to take and digest double the quantity of food I intended him to consume. In the beginning he was put on peptonised milk ¾ of a measure per diem. This was increased to 1 to 1½ measures in a fort-night. Subsequently he asked my permission to take a rice meal once. I assented to this. Later on I permitted him to take two rice meals a day like the other inmates of the house. But I had forgotten to tell him to stop the milk. Some time later I found to my agreeable surprise, that he had been taking his usual rice meals, as he used to do before his illness, in addition to a measure of milk. When I discharged him after a course of injections, lasting for 8 months I could find no physical signs in the chest. He had neither diarrhœa nor fever, and he was fit for hard work. He had gained 45½ lbs. in 8 months. He weighed 78½ lbs. on admission and 124 lbs., when discharged. The medical friend who had sent him on to me, had no hopes of recovery. When I asked the patient after discharge, what he thought of the injections, he replied "you have saved my life." Satisfactory results were obtained though the patient was living in a dirty part of Triplicane.

Case 40. A young Eurasian telegraphist came with a history of haemoptysis and cough. He had low fever in the evening. The tuberculin tests (cutaneous and coujunctival) were positive. Tubercle bacilli were found in the sputum about 50 in a slide by the Asst. Professor of Pathology. In the back on the right side dullness was found along the whole length of the right scapula between the spine and the scapula. Moist rales were heard during inspiration. In the front, above the right clavicle the percussion note was suspicious. There was a hollow below the middle of the right clavicle. He was treated for a year and had a complete course of tuberculin. When discharged he had gained 20 lbs. in weight and had lost his cough and fever. I was unable to detect any tubercle bacilli on repeated examinations. As he was a Government servant he had to produce a certificate of fitness before joining the appointment. So he went to a Senior

Medical Officer who was satisfied with his condition. The father of the young man and a brother of the young man who are both medical men are satisfied that he has been cured. See fig. 53.

Case 42. Another Eurasian telegraphist. He came with a history of cough, fever, poor appetite and dyspnea. He was in Turban's stage III. Both lungs were affected largely. There were small cavities in both lungs, about the level of the angles of the scapula ; a large number of thin bacilli were found in each field by Col. Donovan. The temperature was sub febrile and the evening temperature varied from 99° to 99·6° After injections for 8 months I was able to detect only one bacillus in 3 fields. After 10 months, I could not get a specimen of phlegm for examination as he had no cough. Later, the only specimen I could get contained no bacilli. During the course, he complained of occasional attacks of dyspnea which I thought was due to contraction of fibrous tissue round the lesions. As he was in a hurry to get away and pressed me to push on the doses, I was foolish enough to skip through a dose. The result was a relapse, with reappearance of cough and bacilli in the phlegm. So he had to be put back to bed. The treatment was subsequently resumed with weaker doses. He is still under treatment. His temperature is at present normal and he has been able to rejoin his post and do his work. Here is an extract from his letter to me on the value of the injections ; written 6 months after commencing the course.

"My violent attacks of coughing were so troublesome that I used to bring up my food at midnight, every night ; more especially if I happened to eat such articles as pork and bacon. Besides there was scarcely half an hour that would pass during the day, when I would not cough. I often thought I would burst a blood vessel. I invariably expectorated a yellowish green stuff sometimes tinged with blood. The cough was violent and the phlegm was increasing."

"In a month's time after starting the injections my cough was considerably better, appetite increasing as well as my digestive powers strengthened, so much so, that I ate daily half a pound or more of pork and bacon, at a meal, daily and easily digested it.

I am now 6 months under treatment and cough twice a week (ordinarily and not that hacking and harassing cough that I used one time to dread). I eat anything now, irrespective of being a heavy article of food, night or day and feel all the better for it. I must say that at the present time I find it a difficulty to expectorate. In fact there is no phlegm in the chest as I used at one time to feel." See Fig. 55.

Case 32. A case of diabetes and consumption. (Stage III). His temperature on admission is shown in the accompanying chart. The tuberculin tests, conjunctival and cutaneous, were positive. Both lungs were affected (the upper lobes) and in the right lung he had a fairly large cavity. He had hoarseness of the voice. Tubercle bacilli were found in large numbers and there was a large amount of sugar in the urine. He had been operated for Ischio rectal abcess 14 years before. His diabetes began 6 years before admission, and the pulmonary tuberculosis began 3 years before admission. His mother had died of pulmonary tuberculosis. The evening temperature ranged between 100° and 101·3.° The case looked absolutely hopeless, and I refused to have anything to do with him. But the man told me that he knew his case was hopeless and wanted to know what else could be done to him, if I refused to give the injections. As I could suggest nothing but dying in peace, he insisted on being injected. Then I told him that I didn't like to inject in such cases unless my hands were forced. He said he would take the risk and asked me to inject. And I consented to inject. To add to his troubles (diabetes, pulmonary tuberculosis, and fistula in ano), the Madras hotel food brought on an inter current attack of dysentery lasting for a week. I had to treat him for dysentery and give a number of injections of staphy lo coccus vaccine from time to time. His progress was very slow. As dieting was a matter of considerable difficulty, had to get him admitted into the Royapettah hospital where he stayed for nearly 3 months. Col. Donovan found bacilli in his sputum and confirmed the presence of the cavity in the lungs. The accompanying chart shows the condition of the temperature before discharge. He was able to take walks of 3 or 4 miles every morning. I may add here that the sugar disappeared from his urine very early in the course of the treatment and never reappeared again. The patient was not completely cured. If he had stayed another 6 months, I might have been able to do more for him. But the results obtained were beyond my expectations. I have not heard from him since discharge. See fig. 54.

Case 26. A student of 23 years came to me complaining of pain in the chest and dyspnea. He wanted urgent relief, as he had to appear for the B.A. Examination within a few weeks. He was not aware of any fever. But when I took the temperature, it was found to be over 100 F. His lips and conjunctive were quite pale. He had no appetite. His heart was found on *the right side of the chest quite external to the sternum.* There was considerable pleural effusion on the left side and some effusion on the right side also. The tuberculin tests were positive. Fine crepitations could be heard all over the lungs. I advised him to get himself admitted into the General Hospital. The condition of the temperature is shown in the accompanying chart. His chest was tapped four days after admission, and 40 ozs. of fluid were let out. A fortnight later he was tapped a second time and some 10 ozs. of blood stained fluid were withdrawn. During his stay of 6 weeks in the Hospital, his minimum temperature came to 98 degrees, only on two occasioins. He was discharged from the Hospital after 6 weeks, and asked to try a change of climate. On discharge his brother-in.law consulted me about the future. I did not approve of any change in his condition at that time as I had very faint hopes of his recovery and as I was of opinion that he should not die in a strange place. It is very cruel to advise hopeless patients, especially poor and middle class patients, to go to a strange place for a very faint chance of recovery. I advised the patient to stay in Madras though that summer was the hottest I had seen in Madras during my stay of nearly 30 years in Madras. My first attempt was to reduce the temperature by enjoining absolute rest in bed. His heart had gone over to the left after the tapping in the Hospital, though the cardiac dullness still extended to the midsternal line. No rales were heard. On the left side below the level of the scapula the percussion note was dull and the lung sounds were feeble ; on the right side also there was dullness over the base of the lung. The supraspinous region on the left was dull, the vocal resonance along the vertebral border of the left scapula was increased. On the right side the percussion note was slightly tympanitic.

After rest in bed for 26 days, the maximum temperature came to 100· 2°. As the patient's anemia was increasing and as the summer heat was intense, I decided to assist nature by polyvalent anti-strepto-coccus serum-injections and gave 3 injections of serum 10 cc on each occasion. Five days after the third injection, I gave a small dose of tuberculin hypodermcially. This was followed by a slight reaction for 2 days. The maximum temperature being under 100 ° on the 3rd and the 4th days, I repeated the injection. There being no further rise of temperature to 100 °, I went on gradually increasing the dose of tuberculin and after the 15th injection the temperature became perfectly normal both morning and evening. The patient went on improving in digestion also. The subsequent progress was uneventful except for a relapse of the pleurisy when he had a fresh effusion in the left pleura. On that occasion moist rales were heard in the interscapular region. The maximum temperature rose in the evenings to 100 ° to 101°. A syringeful of fluid was taken from the pleura and injected subcutaneously in the upper arm. And a few days later when the large aspirator syringe was used to tap the pleura no fluid was detected. The hypodermic injection seemed to have done him good. He subsequently progressed satisfactorily. The maximum dose reached was 1 m. gm. As he exhibited an intolerance to it the injections were stopped. He is now doing well and is working as a clerk in one of the Madras public offices. See Figs. 56, 57, 58 & 59.

Case 37. Shows the value of the anti-strepto-serum and the necessity for care in the use of tuberculin. She was a girl of 17 two of whose sisters had died of conception. She came from an exceptionally long lived stock. One of her sisters contracted tuberculosis and she had died of it some years previously. In this case the infection was traced to a consumptive milkman who was supplying milk to the house. She was long treated for malaria and subsequently died in stage III. Two years later another sister died. I am not aware of the exact cause, but I suspect, it was also pulmonary tuberculosis. Another sister who was also infected died after the 3rd confinement when the treatment of this patient was going on. Two years previously this patient had complained of cough and had been treated by a medical practitioner in the mofussil who suspected pulmonary tuberculosis and applied the tuberculin tests which were positive. The patient had the advantage of an early diagnosis; but not of a rational treatment. She was submitted to tuberculin injections, conducted on wrong lines for about 5 months in the mofussil and subsequently came over to Madras for treatment. When I took charge I found she was suffering from vomiting, diarrhœa, fever and cough. When I took the temperature in the morning it was found to be 99· 8°. As early in the course of my practice, I found some patients were ungrateful enough to think after the end of the course of the injections that they were not as bad at the beginning as I thought, I have made it my practice for some time past to make the patients keep a record of their temperature for at least a week, before taking them on hand. The girl's temperature when she came under my charge is shown in the accompanying chart. As the girl had diarrhœa and vomiting I put her on peptonised milk and enjoined absolute rest in bed. On physical examination dullness on percussion and medium sized moist rales were detected on both sides in the supraspinous and inter-scapular regions along the whole length of the scapula. The vocal resonance and vocal fremitus were considerably increased on the left back (upper half), and the breathing was bronchial in the same area. In front the infra-clavicular regions were dull. Vocal resonance was also increased. On the left, just outside the sterno-clavicular junction on the left side, there was a tender hollow patch. The cough was dry and hacking. I could get only a small amount of phlegm in which I could not detect bacilli. She was in stage II of Turban, She was kept under observation for more than a fortnight. But the temperature, recorded every 4 hours, never came down below 99 ° on any occasion, in spite of the rest in bed. The diarrhoea and vomiting also continued. So I insisted on her removal to a house near mine. Two days after her arrival I gave a dose of anti-strepto-coccic serum and the result was dramatic. The temperature came down the same evening and never went up again as high as before the injection. On the following day she had her period. It might be said that the drop in the temperature was due to the period. But I am inclined to think it was really the result of the injection ; for

Firstly, previous menstrual periods did not have any such effect

Secondly, the temperature did not rise again for more than 10 days.

Thirdly, an injection of tuberculin very often precipitates the menstrual period, and the injection of the anti-strepto serum might have had a similar effect.

The following table illustrates the relation between the injections and the menstrual periods in this very case later on in the course of the treatment.

August	21	Injection.
,,	22	Menses.
September	14	Injection, Menses.
,,	14	
October	12	Injection.
,,	14	Menses.
November	9	Injection.
,,	10	Menses.
December	3	Injection.
,,	5	Menses.
January	3	Injection.
,,	4	Menses.
,,	28	Injection, Menses.
,,	28	
February	22	Injection.
,,	23	Menses.

Whether the cause of the fall was the menstrual flux or the injection, or both, the temperature never rose again for over 10 days and gave me an opportunity to give the tuberculin injections.

The tuberculin tests had been applied by a mofussil practitioner some months previously and had proved positive. As I desired to know what amount of response there was in the system I applied the tests again and found them both positive. Under the tuberculin injections the girl made satisfactory progress, The course of injections had to be interrupted from time to time on account of domestic troubles. Her course of treatment has not been completed yet. See Figs. 60 & 61.

Case 56. A young man of 23 years. Had slight dullness and feeble respiratory sounds in a patch about 2 inches square, just to the inner side of the angle of the scapula. He came with a history of cough, fever, haemoptysis and a feeling of great exhaustion. Van Pirquet's test was positive. When discharged he was perfectly healthy. The temperature was brought down by 2 injections and was normal after 3 injections. See Fig. 62.

The beneficial results of tuberculin injections are further illustrated in figures 63, 64, 65 & 66.

Tuberculin is not a universal remedy for all stages of pulmonary tuberculosis. It has its limitations. It can be expected to cure only in stages, 0, I, and I—II. In cavity cases the most that can be expected will be an amelioration of the condition. It is not suitable for resting febrile cases. Suitable cases for tuberculin injections must fulfil certain conditions:—

1. A fairly good digestion.
2. An evening temperature not exceeding 100°.
3. Absence of mixed infections,
4. Freedom from frequent haemoptysis.
5. Absence of rapid extension as in the cases of galloping consumption.

In certain cases where temperature is high in the evenings the temperature may be brought down by absolute rest in bed or by anti-strepto- coccus injections. Tuberculin is not a perfectly harmless remedy in the hands of the inexperienced.

Case 3 (See fig. 68) A young girl of 17, with considerable affection of both lungs) shows that the injections in an unsuitable case can make a patient worse. In this case, rest in bed brought down the evening temperature to 99·6° As Van Pirquet's cutaneous test was positive, the physician in charge thought of injecting tuberculin. But after giving 6 injections, the patient got considerably worse. But unfortunately the injections were continued and the result was high continuous fever, which is an indication of rapid extension of the disease. This chart also brings out the fact that the gain in weight is by no means an indication of improvement by itself. This particular case might have improved satisfactorily by the sanatorium treatment. There is a statement in the book on tuberculin treatment by Bandelier and Roepke to the effect that tuberculin B. E. is the best antipyretic in pulmonary tuberculosis, and this statement has induced some general practitioners to employ the tuberculin B. E. in febrile cases with disastrous results. I wrote to Bandelier and to Roepke and asked them whether they advise using tuberculin in febrile cases. Both have replied that tuberculin *should not be injected* in febrile cases.

To be able to inject tuberculin with success in febrile cases requires considerable experience. Success depends on the careful selection of the cases and attention to various details such as the amount of lung damage, the nature and duration of the fever, the condition of digestion, the amount of rest necessary, the selection of the right time for the injection, correct spacing of intervals & c. These details vary from case to case. The fever can be controlled to a large extent by the use of rest in bed in open air, the use of anti-strepto-coccus serum and the use of auto-vaccines, the regulation of the bowels and the regulation of the diet. See Figs. 67, 68, 69 & 70.

Figs. 58 & 60 show the value of the anti-strepto serum in reducing the temperature.

Cases 55, 79 and 48 show the influence of rest in reducing the temperature. See Figs. 67 and 70.

Case. 78 (See figs. 75) shows the value of auto-vaccine in obstinate cases. I must confess that I have found the auto-vaccine useless in a large number of cases of mixed infection with acute tuberculous fever of the type 3. In severe cases of mixed infection the temperature may drop down as soon as large cavities are formed. And in these cases if auto-vaccine be administered the drop of the temperature may be wrongly attributed to the auto-vaccines.

It is not unusual to find rises of temperature after attacks of indigestion. An attack of indigestion in a febrile consumptive in stage III is likely to increase the severity of the disease. Case 15, Fig. 76 shows the possibility of reducing the temperature with carefully adjusted doses of tuberculin and the possibility of an increase in the severity of the disease, by an attack of indigestion.

During a course of injections the doses should be increased in such a way as to produce the least rise of temperature. The rise of temperature may occur on the same day, or more usually in my practice on the next day, or sometimes on the 3rd day. If there be a rise of temperature 72 hours after the injection, the rise is very likely due to other causes, exercise, excitement, indigestion, constipation &c. Sometimes there is a sharp rise of temperature within 24 hours, though the increase in the dose is slight. If such a sharp rise be followed by a rapid fall within 24 hours, the patient is not likely to be hurt by it. But if a sharp rise be followed by a slow descent lasting several days, the chances are that the dose used is too big. During the course of treatment lasting about 6 to 8 months, a few such severe reactions are likely to take place. It is impossible to avoid all reactions altogether. But 4 or 5 reactions during 6 to 8 months are not likely to prove hurtful. But if such reactions be frequent say 2 or 3 times in a month the tuberculin treatment is likely to prove injurious.

The accompanying charts of cases 5, 6, 37, 38, 27, and 39 show that occurrence of the reaction at varying intervals after the injection. (See figs. 71, 72, 73, 77 and 78). Those cases in which the tuberculin tests are followed by a sharp rise of temperature are likely to exhibit great sensitiveness to the tuberculin injections in the first month.

Case 28 was a very suitable case (in stage II.) for injection. But the medical officer refused to permit me to continue the injections. The poor patient was discharged from the hospital and subsequently died. I very much regret that it did not get the benefit of the injection. See fig. 74.

The dosage cannot be judged from the directions on the wrappers of the bottles of tuberculin. Each case differs from all others. I have not had two cases in which I found it possible to use the same doses at the same intervals. In some cases, an intolerance is exhibited to an increase of the dose beyond a particular limit. No doubt by a little tactics it would be possible to overcome the intolerance. But it is highly desirable in such cases to stop the treatment or to change the variety of tuberculin. Some cases stand very large doses of tuberculin and profit by them. See Fig. 79.

In other cases, (for example, Fig. 80) a repetition of the dose not tolerated, gives rise to hyper-sensibility. When a repetition of the same dose or a weaker dose produces a more severe reaction than on the previous, one must stop at once.

In case 38 (Fig. 81) though 5 m. gm. of Koch's old tuberculin was tolerated during the test, 1/80,000 m. gm. B. E. produced a severer reaction. In the chart 82 is shown, side by side, the effect of the same dose on 4 patients. In case 87 no reaction was produced; in case 79 a slight reaction was produced; in case 92 a slightly greater reaction was produced; while in case 86 whose temperature for 2 days before the injection had been normal, the reaction was very severe.

Again fig. 83 shows, the different effects of the same dose on different individuals. With a dose of 1/500,000 m. g., case 99 had a slight reaction, while case 97 showed a greater reaction though the previous temperature had been more satisfactory than in case 99. With a dose 1/300, 000 mg. it was case 99 (which on the former occasion had a slighter reaction) which showed a more severe reaction. Again in chart 84, the effect of a small dose in case 39 with a normal temperature, and the effect of a large dose (20 times the other one) on case 40 with a sub febrile temperature, are contrasted. The febrile case gave a slighter reaction to a comparatively big dose while the non febrile case gave a severe reaction to a far weaker dose. The spacing of the intervals between the injections and the strength of the subsequent doses, depend to a large extent on the amount and duration of the reaction produced. We have also to pay attention to the physical signs, the symptoms, and the amount of local and constitutional reaction.

Thus it will be seen that each case has to be individually studied, if tuberculin is to be used with satisfactory results and that no two cases can be treated alike. Here I cannot help quoting some extracts from the Journal of the American Medical Association, September 16, 1911; as they exactly express my views on the subject in language better than what I can command. Pottenger of California expresses himself as follows:

"That the intelligent employment of tuberculin in the treatment of tuberculosis, is attended with excellent results is now almost universally admitted. Still there are some who are unconvinced. Absolute unanimity of opinion however has rarely been attained in medicine and we are not expecting it, in this instance."

"Tuberculin is by no means an easy remedy to administer. It requires much careful study and close observation, to be able to use it to the best advantage. The proper administration requires the giving of the right dose at the right time. To administer the right dose at the right time requires judgment born of experience; for it cannot be determined by rule." "Tuberculin treatment is not what it is often supposed to be, merely the introduction of a certain number of drops of a certain dilution of tuberculin into the body tissues by means of a hypodermic syringe and repeating it at certain intervals according to rule. If this is all, there is in tuberculin treatment, it might as well be turned over to a nurse or to a patient for self-administration. Tuberculin can produce a varying degree of good results and also a varying degree of harmful results according to the method of its administration." "Its proper administration can be carried out only when the physician has an intelligent idea of the nature of the remedy and its action and when he has made a careful study of tuberculosis both as to its clinical course and its pathology."

"This should be self-evident; yet it is disregarded in practice if we are to judge from the manner in which it is often employed to day. It is often administered as though it were an indifferent remedy and as though tuberculosis was a disease of no seriousness. The dosage of tuberculin is modified by many influences such as individual susceptibility, the character and location of the lesion, whether it is extensive or circumscribed, active or quiescent according to the condition under which the patient is being, treated; whether in an instution or in ambulatory practice; whether he is resting or working; according to the accompanying complications and conditions, such as cold, influenza, bronchitis, haemorrhage, menstruation; also according to the preparation employed. There can be no set rule."

"The man who understands this remedy individualises and aims at the production of results. He forgets stated intervals and rules for increase of dosage and is guided entirely by the effect obtained. A hypodermic syringe filled with tuberculin cannot cure tuberculosis. It requires an intelligent brain to guide it."

"Unfortunately those who use tuberculin most intelligently are divided into two camps, those who believe in using progressively larger and larger doses, suiting the dose to the patient and the pathologic process, and spacing the dose according to its size and the condition present; and those who believe in the repeated small doses given at stated intervals.

"Between these two camps there are many stragglers who, without any particular idea, are following no rule, but simply inject tuberculin, trusting to the Lord to take care of the patient."

"I have given both methods a fair trial and I produce the best results by the progressively increasing dosage."

"I am of opinion that there should be some man in every community who is capable of using tuberculin in the treatment of tuberculosis. The men who have only one or two patients a year to treat should not think of employing it. They do not have sufficient experience to use it correctly."

Dr. Rothschild of San Francisco states :—"The necessity of individualising in every case is undoubtedly of great importance. I am in harmony with Dr. Hare in condemning the houses which put tuberculin on the market in serial dilutions, and induce the general practitioner to treat tuberculosis *according to the schedule*." Dr. Probst of Columbia states :—"I wish to emphasize the danger of the improper use of tuberculin." Dr. Ritter of Chicago : is of opinion that Tuberculin is a double edged sword and that it should be used by those who are familiar with it.

Dr. Shephard of California writes :—"After all is said and done, it is the man behind the gun that does the work. In the treatment of no other disease, does the personal equation of the attending physician have such an important bearing. It is the man who administers the remedies, who produces the result.

The disappointment in the result of tuberculin treatment seems to be due to 3 causes.—Faulty Technique, *a failure to recognise the limitations of tuberculin*, and an inability to observe the benficial or prejudicial changes which the remedy produces with sufficient accuracy. Tuberculin has only a specific action against the tubercle bacillus and its toxins. It cannot cure mixed infection."

Dr. Latham of St. George's Hospital London, writes (in his System of Treatment) as follows:—"Tuberculin is most useful in those cases of pulmonary tuberculosis in which auto inoculation is not excessive (*i. e.*) in a febrile chronic cases. It turns the balance in favour of improvement and recovery in many cases in which ordinary sanatorium methods have produced little effect. Tuberculin therapy is not easy and there is no doubt that it may be productive of great harm or even fatal results in inexperienced or careless hands. In all cases in which tuberculin is of service it should be given for not less than one year. Each case must be considered on its merits."

Dr. Latham further writes :—" Every year, one might almost say every week, a new specific treatment for tuberculosis is advertised. At the present moment, I know of none, which has really stood the test of extensive trial, whether it be Spenglers IK, Dioradin, Marmorek's serum or Dewar's method of intervenous injection of Iodoform, although from time to time suggestive cases are brought forward.

Dr. Sezary of the Tuberculosis dispensary of the Hospital Laennec, Paris, is of opinion that tuberculin is a therapeutic agent, whose management is very delicate and that a rash or ill regulated administration may bring on disasters.

The best proof of the value of tuberculin lies in the fact, that in 1905 tuberculin was used in only 36 out of 123 private and public sanatoria, in Germany, while in 1907 this remedy was used in 77 institutions out of 135. Tuberculin is a potent remedy and often does much harm in incompetent hands.

The preventive measures necessary to prevent the spread of this disease may be considered under 3 heads:

I. Those intended to prevent the infection of healthy people.

II. Those intended to prevent the conversion of cases of closed tuberculosis into cases of open tuberculosis which are the real sources of danger to the community.

III. Those intended to prevent the spread of infection from the open cases.

As regards infection from bovine sources the possibility of infection through milk and meat in a small percentage of cases has no doubt been recognised by various investigators in Europe and America; but in this country we may ignore this method of infection for all practical purposes, as milk is invariably boiled and as meat is cooked before eating. The infection through cow-dung is a subject that has not been properly studied yet in India.

I. Consumption may aptly be termed a house disease. The house is the place where the tubercular subjects often become infected and the house is the place where the advanced consumptive disseminates the bacilli most, and infects everybody near and dear to him. Direct sunlight can kill the bacilli in five or six hours, and diffused sunlight in several days, while proper ventilation greatly facilitates the bactericidal action. The bacillus is a parasite of feeble growth and cannot be grown on the ordinary laboratory media, as easily and rapidly as many other pathogenic bacteria. In the words of Dr. Philip " it demands specially favourable conditions. Even after successful inoculation, while the feeble parasite is struggling to assert itself on the more or less resistant soil, the conditions of environment determined the production of the disease".

Airlessness, sunlessness and foodlessness afford great advantage to the tubercle bacilli and enable them to implant themselves in the system.

The prevention of infection in the case of healthy people is mainly a matter of general sanitation. The avoidance of intimate contact with the consumptive in the house, the segregation of the consumptive in a separate room (if he is retained in the house) the disinfection of the sputum, clothing etc. (in fact everything that has come in contact with the consumptive), the disinfection of the room and its contents, after the death or removal of the consumptive therefrom, personal cleanliness, household cleanliness, wholesome food, proper ventilation of houses, prevention of overcrowding, regular exercise, regular habits, temperance (in food, drink, sleep, and sexual indulgence), prohibition of spitting on the floor,—are all useful and necessary measures in preventing the infection. These are all measures that should be carried out by the individuals. Other measures that should be carried out by the Municipality, are, opening out the congested areas, removal of end houses in blind alleys, demolition of old and narrow houses, widening of narrow dirty streets, efficient conservancy, building of model houses, provision of standard plans for houses of different sizes, provision of parks in crowded localities, *insisting on a minimum breadth of houses* (30 *feet at least if not* 40 *feet*) the provision of open courtyards of minimum size inside the houses, the prohibition of promiscuous spitting *in places of public resort, and above all new building regulations that will give sufficient power to the Health authorities to prevent the erection of insanitary houses.

A very important prophylactic measure, is the education of the public in matters pertaining to hygiene. This can be done:—

(1) by giving instruction in hygiene and school hygiene to teachers during their period of training (of course the instruction must be given by Medical men),

(2) by teaching the elements of hygiene in all the schools (both elementary and secondary).

(3) by the delivery of periodical lectures by the teachers or the Medical Officers in the neighbourhood on elementary hygiene and physiology, to the parents of the boys, in the school buildings, on some prominent holidays (like the Easter, Christmas, or Pongal holidays),

(4) by the delivery of lectures on sanitation in the vernaculars to the villagers by the Taluk Sanitary Inspectors when on tour,

(5) by the broad cast distribution of leaflets in the vernaculars on general sanitation and on the prevention of infectious and endemic diseases *e.g.* Cholera, Small-Pox, Consumption, Plague, Malaria, Elephantiasis, etc.,

(6) by the publication of the same in the vernacular journals of the presidency from time to time.

In schools, short lessons, on general hygiene, on the danger of spitting on the floors and on the danger of licking the fingers, pencils, slates, stamps, &c. should be given. The danger of coughing without covering the mouth and the infectivity of the sputum should be clearly pointed out. The public should be educated up to the fact, that the sputum is as nasty, as loathsome and more dangerous than urine and fœces. In dealing with the tuberculosis problem we must not forget that poverty is a very potent cause of tuberculosis. The under-feeding due to poverty lowers the vitality of the masses. But the remedy for this predisposing cause lies in the hands of philanthropists.

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* It is not enough to pass bye-laws. They must be enforced. It is very common to see now-a-days notices put up in the verandahs of public buildings prohibiting spitting. Such notices are not enough ; people should be told where to spit, and fly-proof spittoons should be put up in various public places as in America. Of course it is needless to say that the spittoons require daily disinfection.

II. The consumptive will not infect others in the earlier stages of the disease; but the moment he begins to expectorate, he becomes a source of infection if certain necessary precautions be not carried out. Therefore it is necessary in the interests of public health to prevent cases of closed early tuberculosis becoming cases of open tuberculosis. Early diagnosis, before the lungs begin to break down, will enable us to cure the consumptives and diminish the sources of infection. The early diagnosis and treatment of consumption really form part of the prophylactic measures.

The treatment of the cases diagnosed as early stages of consumption may be (1) by open air treatment in a sanatorium or (2) by tuberculin injections or (3) by both these methods combined.

My own experience is that all cases of early tuberculosis can be satisfactorily treated by tuberculin injections. The best results are obtained in afebrile cases and resting-febrile cases. I have found the tuberculin injections (with the new tuberculins) very valuable even in cases of mixed infection so long as the evening temperature is under 99·5°. But in resting-febrile cases the stay in a sanatorium is necessary. A combination of sanatorium and tuberculin treatment must of course give the best results; and such a combined treatment is carried out at present, in many of the sanatoria in Europe and America. As sanatoria are costly and can afford only limited accommodation (for a small part of the population) they should be utilised only for cases *which cannot recover by tuberculin injections alone, but which can recover by staying in the sanatoria.* Therefore the very early cases and the hopeless cases should not find entrance into the sanatoria. By prompt treatment of the incipient cases of phthisis, whether by sanatorium methods or by tuberculin injections, the dissemination of the infection can be prevented to a large extent.

III. By far the most important feature in prophylaxis relates to the *disposal of the sputum in the sick rooms.* Scrupulous care should be taken to avoid contamination of the clothing, bedding, furniture, floor, hands, lips, beard or any other portion of the body. The droplet infection should be guarded against, by holding a handkerchief before the mouth, during coughing and loud talking. Disinfection of the sputum, (received in a spittoon), urine, fœces, hands, clothing, etc. is of course essential whether the patient be segregated in his own home or in a hospital or in a sanatorium. As soon as a patient arrives at the infectious stage, it is desirable to remove him to a consumption hospital or sanatorium, where he will have to stay for three months at least, unless he can be efficiently segregated at home. A few months' stay in the sanatorium, would be of great value to him, in educating him and teaching him correct sanitary habits. An individual who has lived in a sanatorium or a consumption hospital, for two or three months, can be depended upon to live in such a way as not to endanger his neighbours.

Notification of all cases of open tuberculosis is highly necessary to enable the Health authorities to take proper action. The notification will lead to the supervision of the surroundings, segregation of the infectious cases, and the search for incipient cases amongst the contacts. Notification to be effective must be compulsory on the part of the medical men but they must be paid a fee for the Notification. It is a mistaken policy to compel Medical men to notify without a fee. The Medical Officer of Health will in this way obtain valuable information about the presence and extent of the infection in the City. The Medical Officer of Health or his Assistant, after receiving information of the existence of the infectious cases, should go over to the houses infected, make an investigation into the sanitary condition of the house and its surroundings, and take steps to improve the sanitary conditions of the house and the surroundings. As for the patient, he should be advised to go over to the consumption hospital for a few months. If he be reluctant, the necessary instructions to carry out home segregation, and disinfection of the sputum should be given. The other inmates should be advised to get themselves examined by private Medical men or in the out-patient department of the consumption hospital.

Compulsory segregation may not be practicable at present. We should depend upon persuasion for the present. If willing to be removed, the infectious cases should be removed to a special consumption hospital and not to a General Hospital as is done at present. The reception of consumption cases in a General Hospital will endanger the safety of the other patients whose vitality has already been lowered by other diseases. Madras is in urgent need of a special consumption hospital, in the centre of the town accommodating about 100 patients at least. The consumption hospital situated in the centre of the town will not be a source of danger to the neighbourhood as the disinfection will be efficiently carried out inside the hospital. The Consumption hospital should have both an out-patient department and an in-patient department. In this hospital the consumptives should be kept at rest and under treatment for two to four weeks. They can subsequently be sorted out into :—

(1) those who after a brief stay and treatment can be turned over to the out-patient department for treatment with tuberculin injections,

(2) those who must be turned over to the sanatorium, the resting febrile cases which are not advanced,

(3) the incurable and hopeless cases which can be kept on till correct sanitary habits are learnt by the consumptives. They can subsequently be discharged or kept on if there be room. These cases should certainly have a ward of their own.

The out-patient department should contain a tuberculin dispensary intended for the tuberculin treatment of the working afebrile and the ambulant afebrile cases. It is the place where the contacts of the consumptives can be examined and advised.

People who can neither take their own temperature nor can get friends or relatives to make the necessary observations, *e.g.* illiterate people, must of course get their injections in the sanatorium. The sanatorium need not necessarily be situated in elevated places or woods. Proximity to the sea is not necessarily objection able. The British health resorts which have a reputation for the treatment of the consumptives, are on or near the sea coast, such as the Sanatoria at Bournemouth, Ventnor, Margate, and Torquay, and the Cromer Sanatorium. A great advantage of the sea side also shared by mountain resorts, consists in the recurring breezes which purify the air. Further the proximity to the seas, tends to equalise the temperature throughout the year. The belief amongst the Phthisio-therapists at the present day, is, that no special climate is necessary for a sanatorium, and that the effects of treatment are mainly due to dust-free open air: Herman Weber highly commends warm climates with plenty of sun light. Dr. Philip of Edinburgh is of opinion that Aero therapy is a measure of universal applicability in all lands and that there is no climate specially favourable for its practice. He is also of opinion that the sanatorium should be easily accessible.

Dr. Galbraith, lately house physician to Dr. Philip, has written "Altitude and climate have been asserted to exert a very marked influence on the course of tuberculosis and yet we meet with sanatoria at all altitudes and in almost all climates with a practically uniform measure of success attending the application of the open air life * * * * The aim of the treatment is to fit the patient for taking his place in the ranks of the workers and not to produce a crop of exotics to live under artificial conditions of climate or altitude. Thus a person, the subject of tuberculous disease should be treated under conditons as little artificial in these respects as possible and as nearly alike as practicable to the conditions under which he will afterwards have to live and work. This view is now generally recognised and all along has been the guiding principle in the Edinburgh system. A public sanatorium must be easy of access from the districts which it is intended to serve."

I have attached hereto a plan for a block of 24 patients (12 male patients down-stairs and 12 female patients upstairs).

The advantages of this plan are :

(1) *There are noarches in the verandah.*

(2) The verandah is wide all round so that the beds with castors may be wheeled into the verandah where the patient can spend the greater part of the day and night in fair weather.

(3) The windows alternating with the doors are raised a little above the level of the heads of the patients in the cots, thereby enabling us to provide fresh air to the patients who are too sensitive to bear any draught, The cots can be drawn against the doorways or windows as is found desirable. The blocks in the sanatorium as well as in the consumption hospitals may be built of this type and may be located on either side of the central administrative buildings. The measures necessary to prevent dissemination of tuberculosis in this country may be summed up as follows :

1. Improvement of the general sanitation in towns as well as villages.

2. Grouping of the villages into village unions for the purpose of securing better village sanitation.

3. Improved building regulations in towns as well as villages.

4. Education of the public in matters pertaining to general health (and infectious diseases)—

(a) by means of lectures, by Assistant Surgeons, Sub-Assistant Surgeons, School Masters, and Sanitary Inspectors,

(b) by teaching hygiene in schools,

(c) by teaching hygiene and school hygiene to teachers during their period of training.

5. The early diagnosis and treatment of incipient cases of tuberculosis.

6. Notification of infectious cases to the Health authorities concerned.

7. Prohibition of indiscriminate spitting.

8. The provision of consumption hospitals and Sanatoria in different parts of the Presidency.

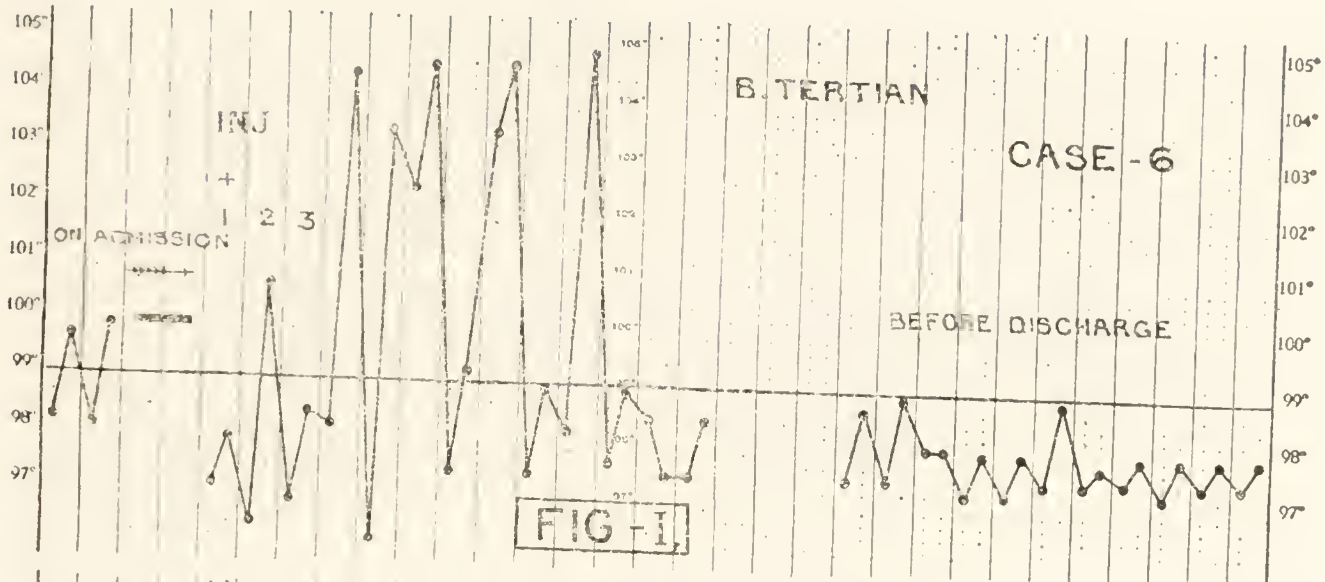


FIG - I

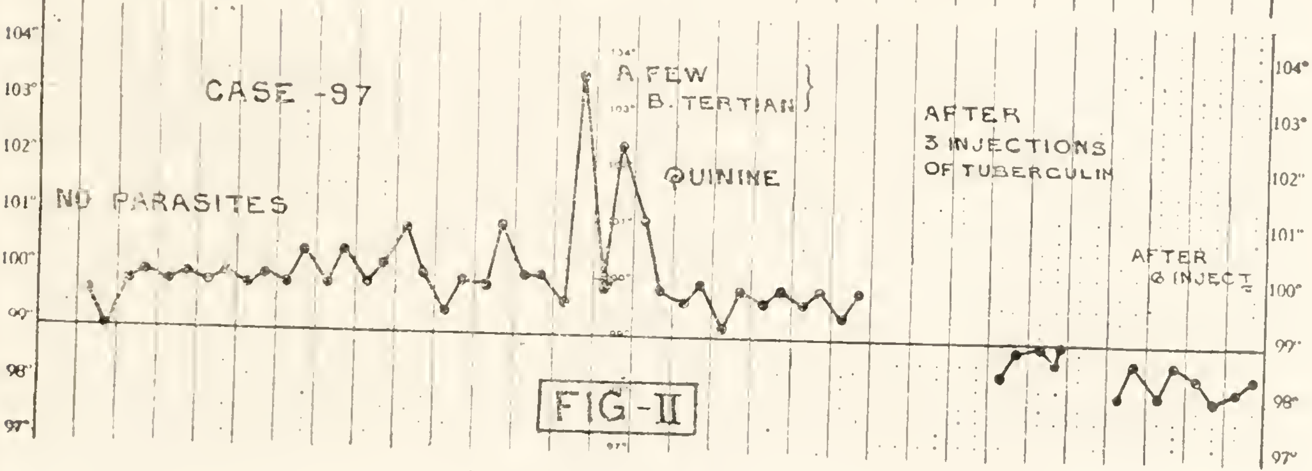


FIG - II

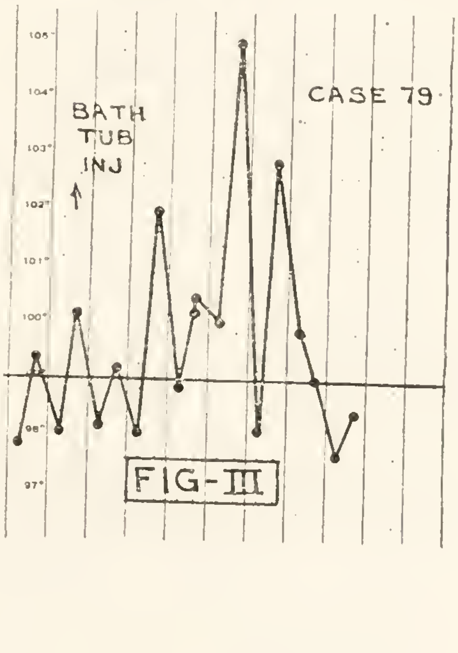


FIG - III

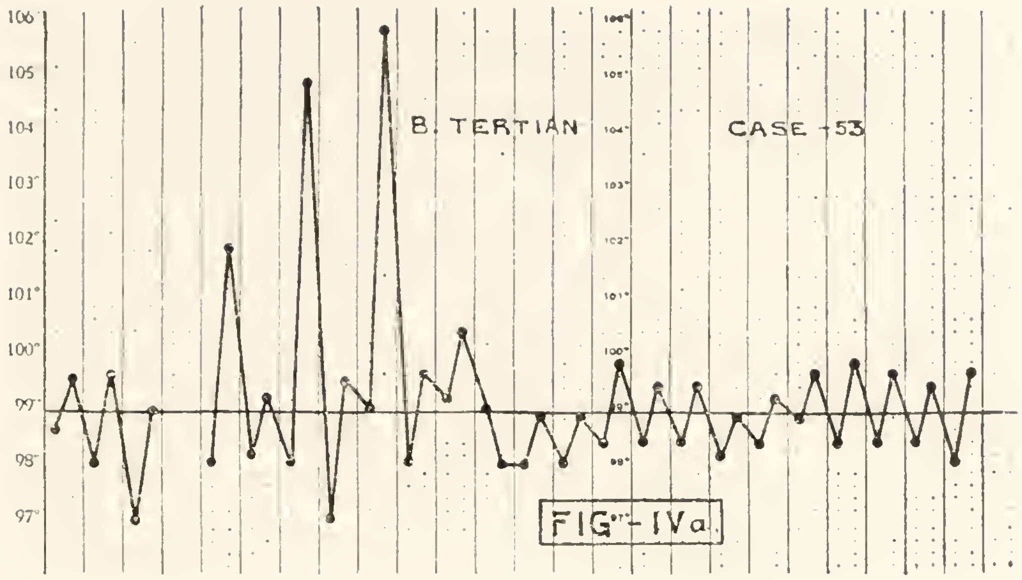


FIG - IVa.

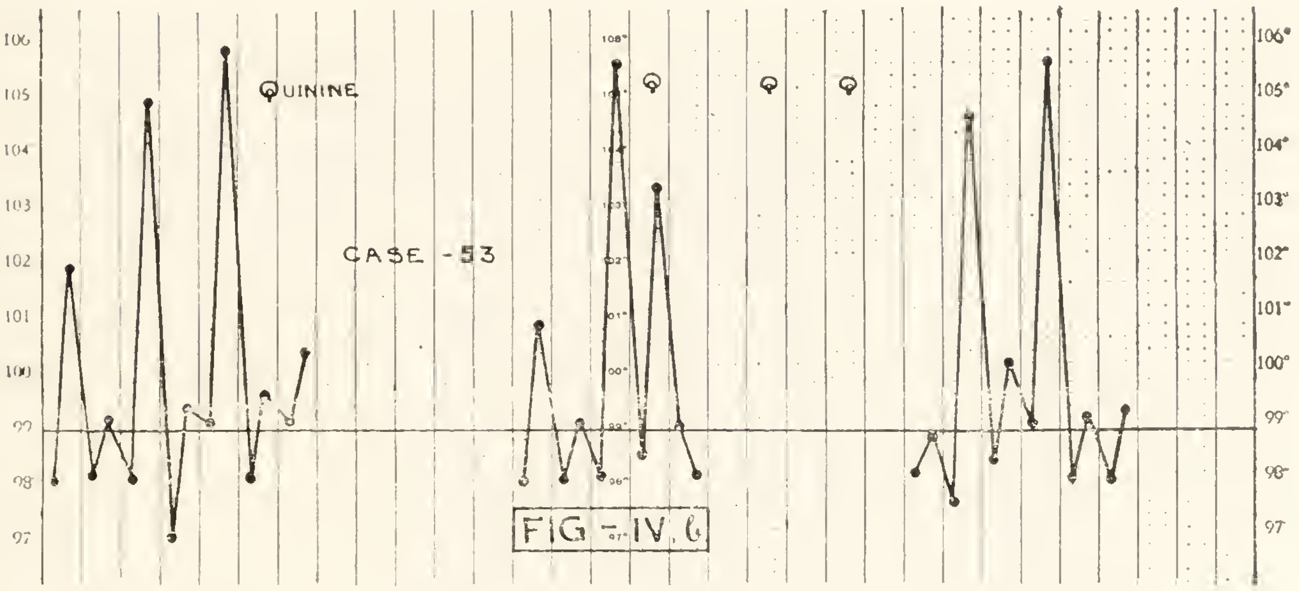


FIG - IV. b

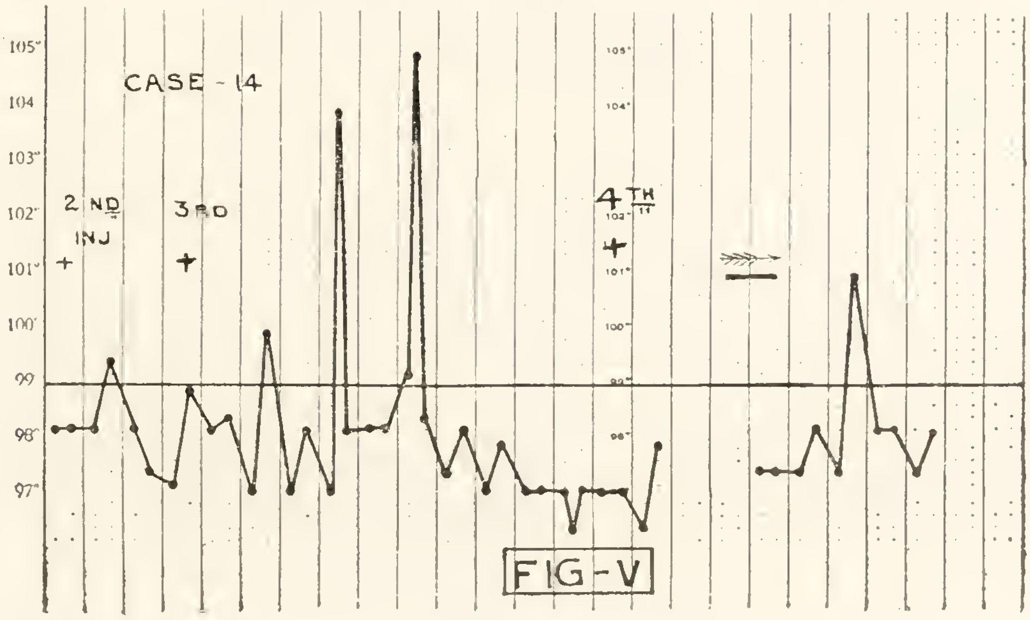


FIG - V

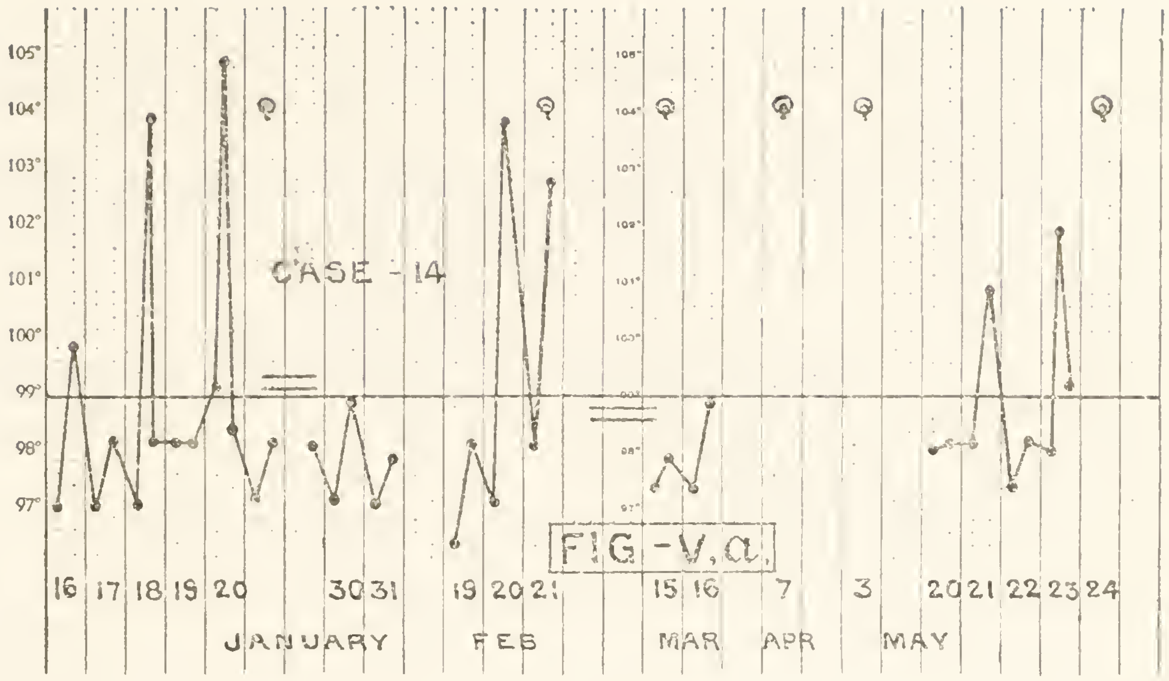


FIG - V, a.

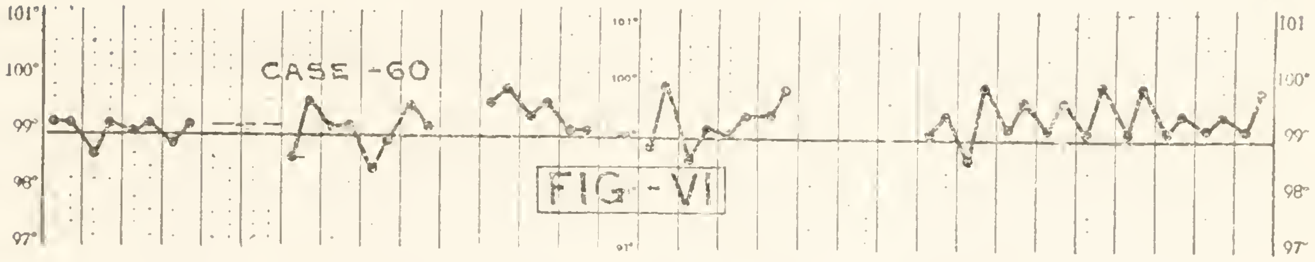


FIG - VI

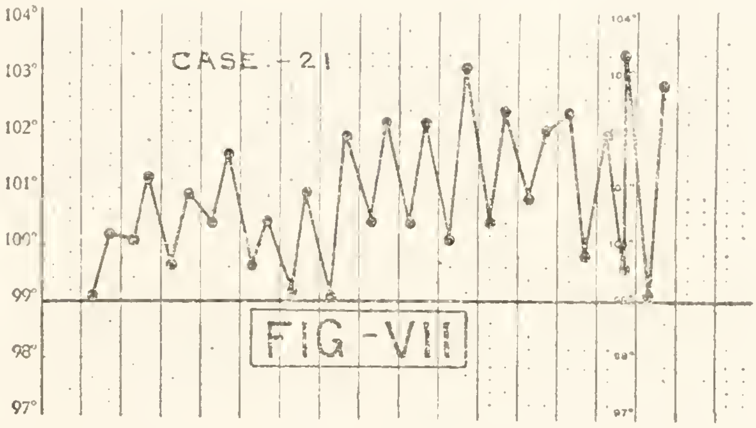


FIG - VII

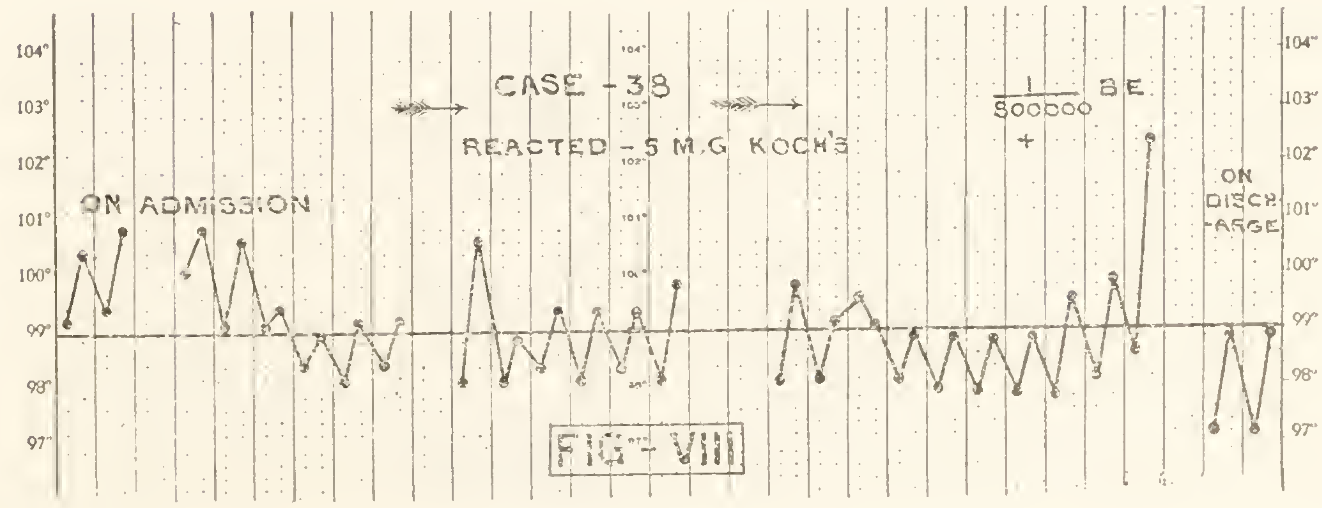


FIG - VIII

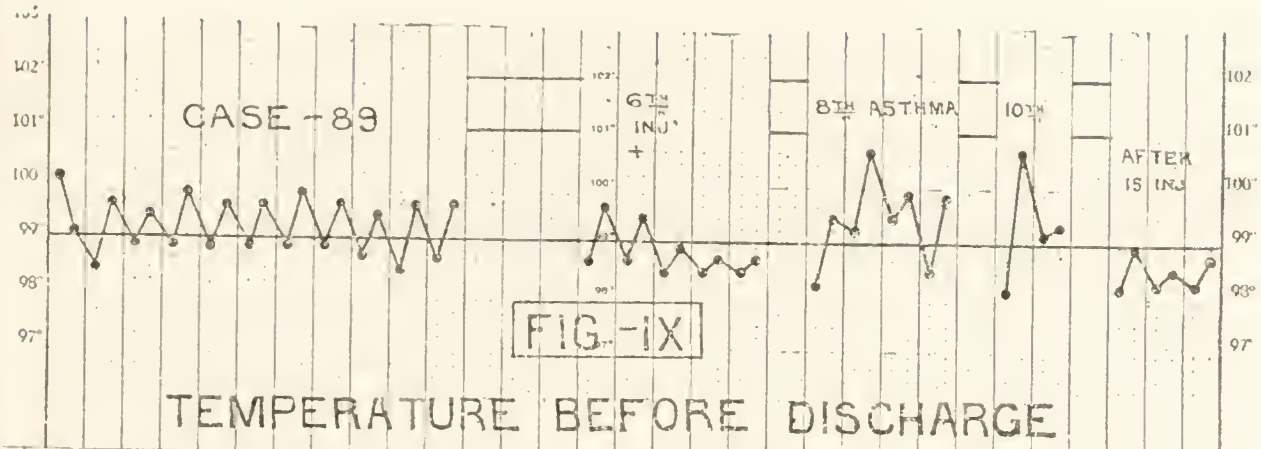


FIG-IX

TEMPERATURE BEFORE DISCHARGE

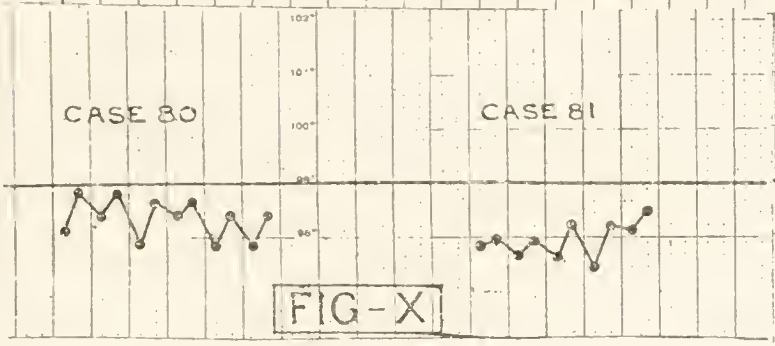


FIG-X

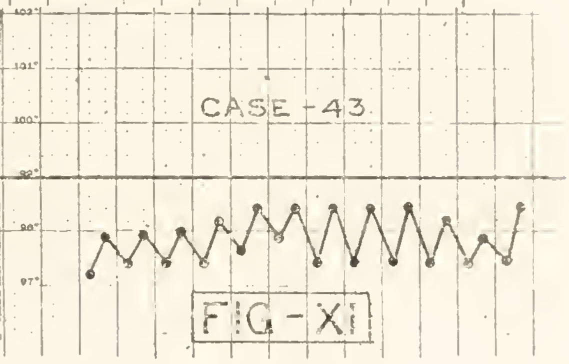


FIG-XI

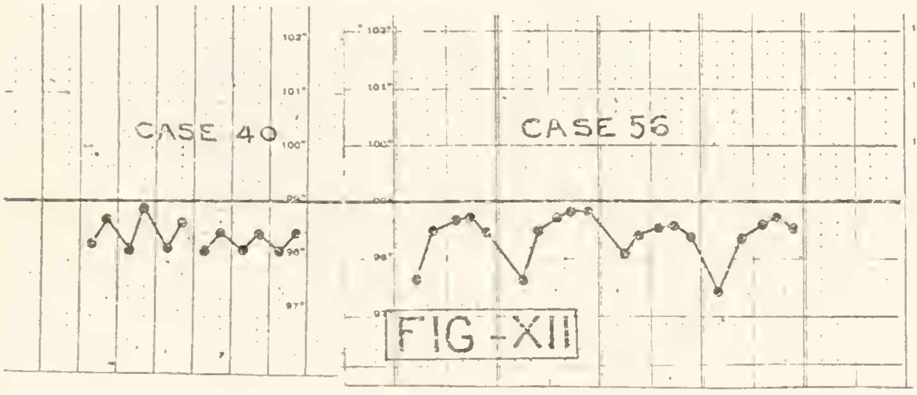


FIG-XII

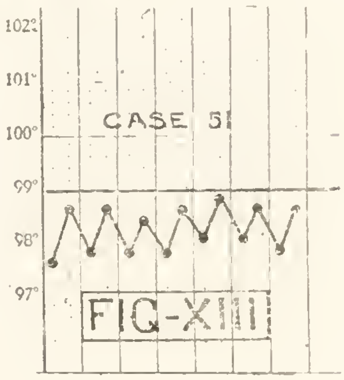


FIG-XIII

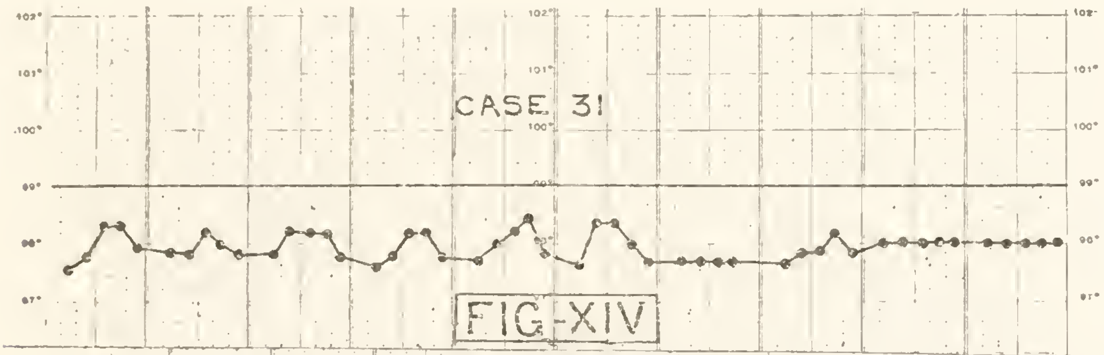


FIG-XIV

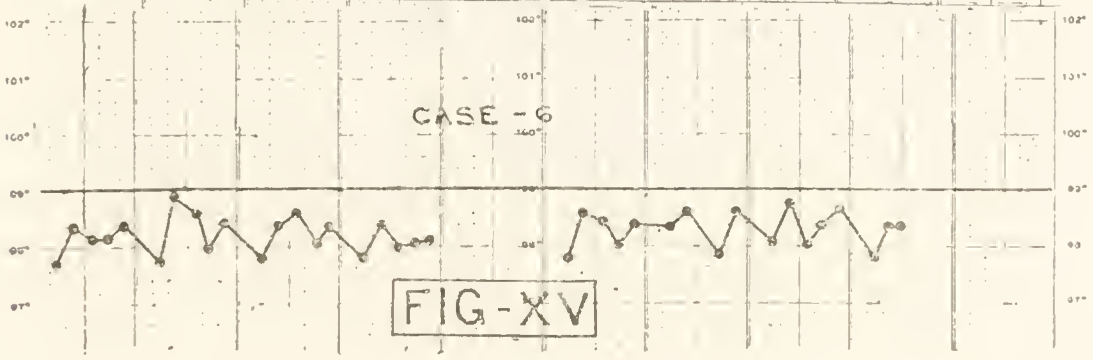


FIG-XV

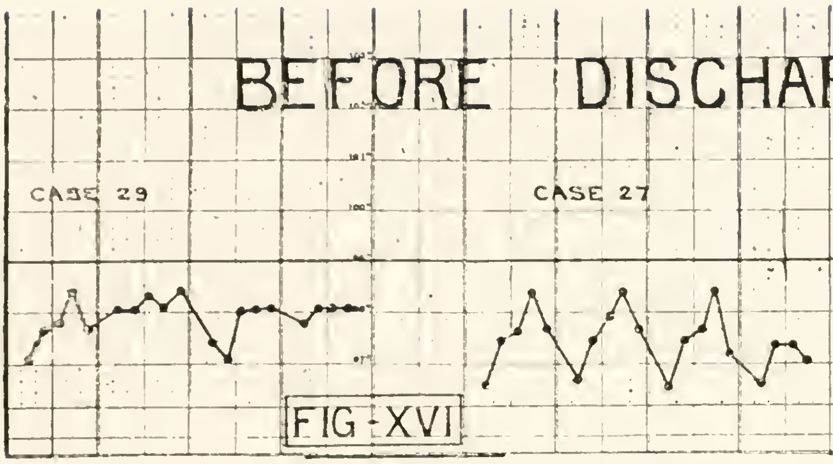


FIG - XVI

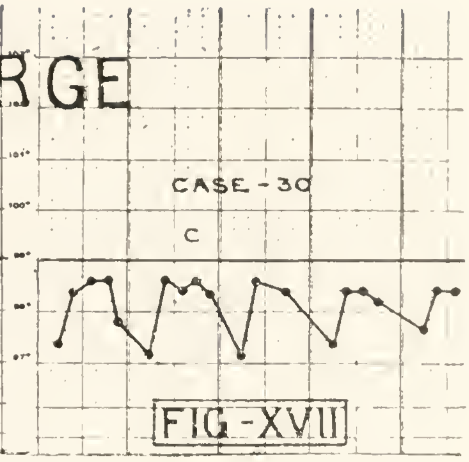


FIG - XVII

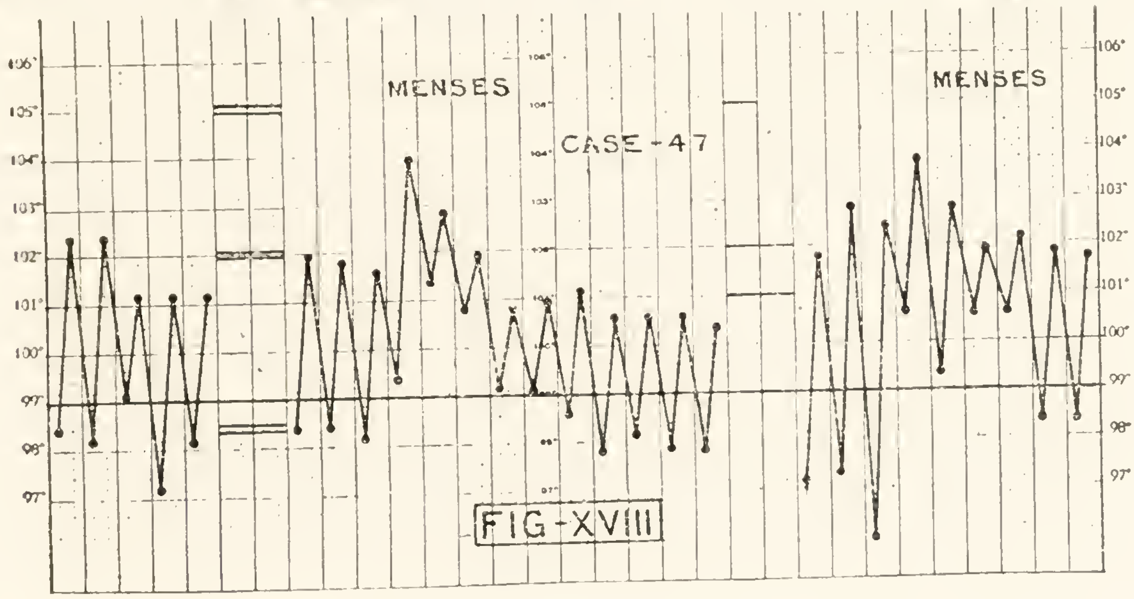


FIG - XVIII

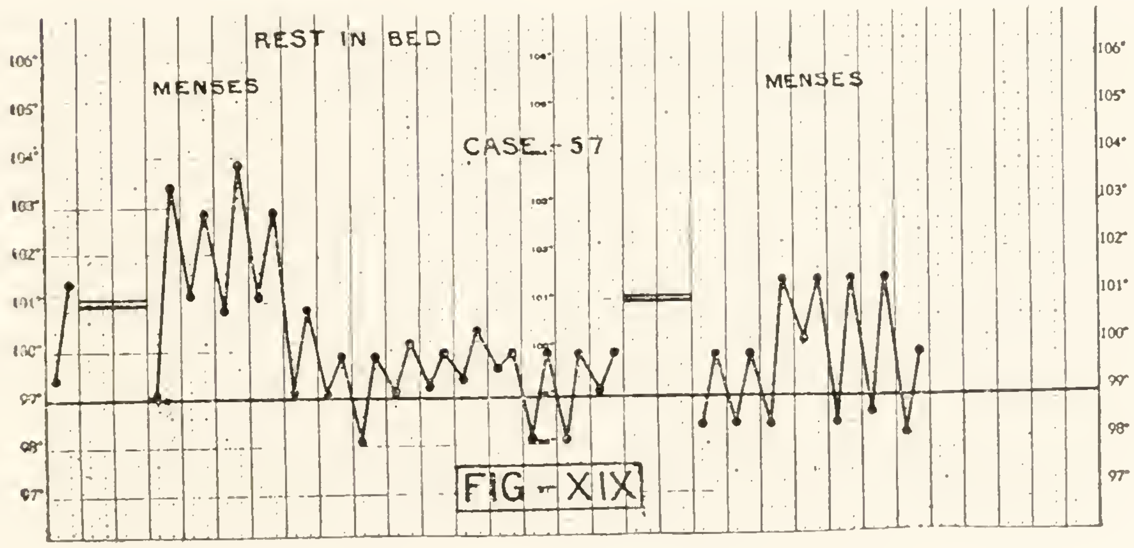


FIG - XIX

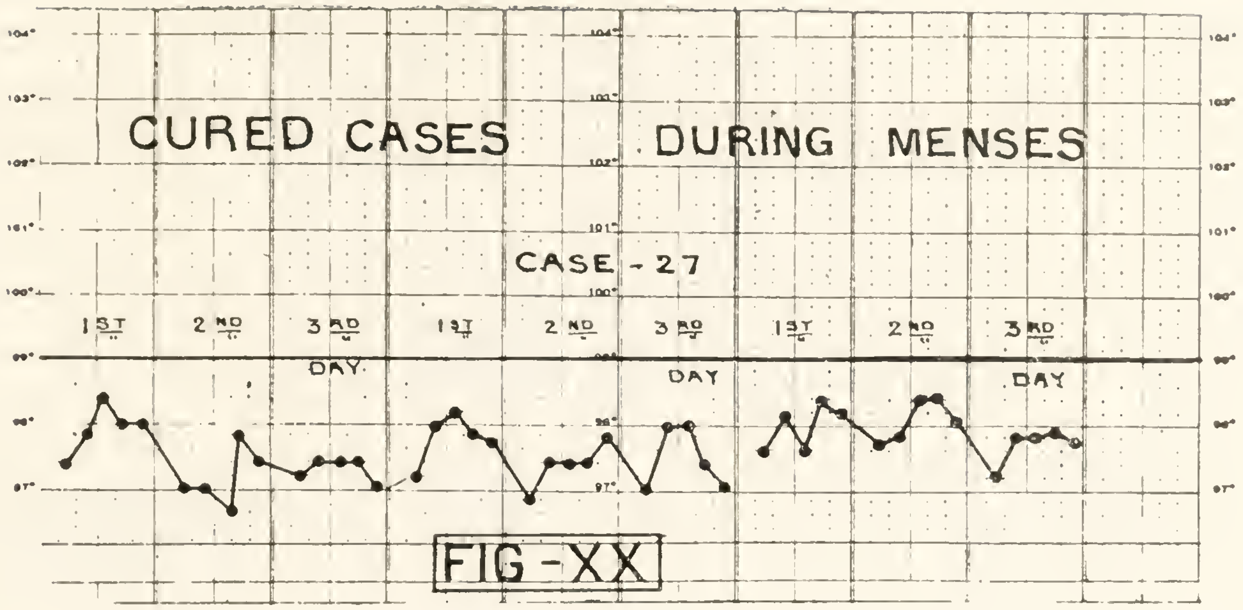


FIG - XX

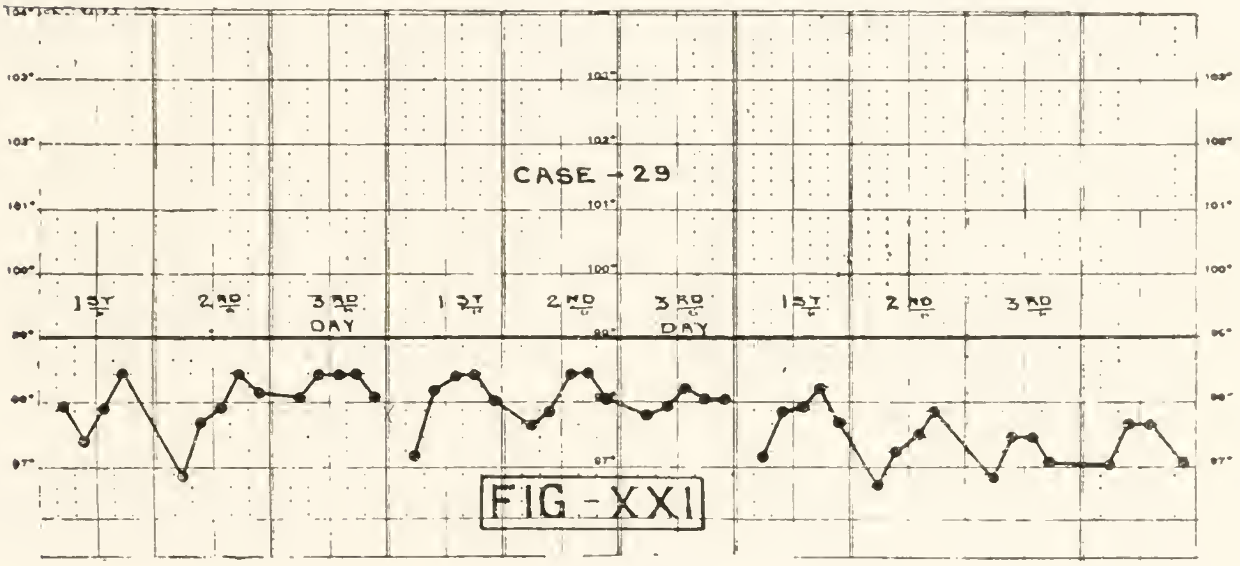


FIG - XXI

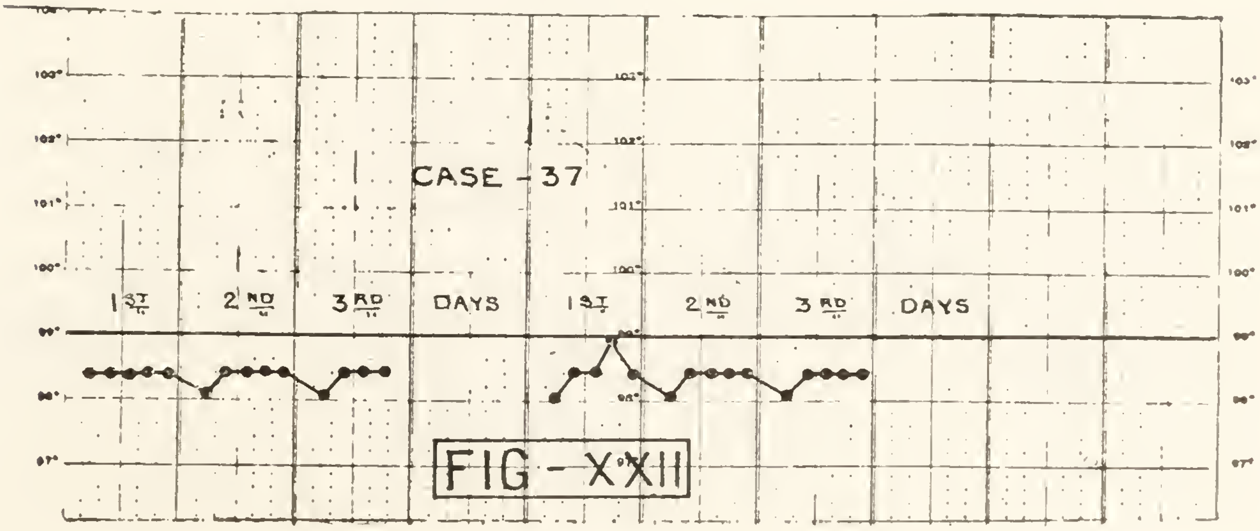
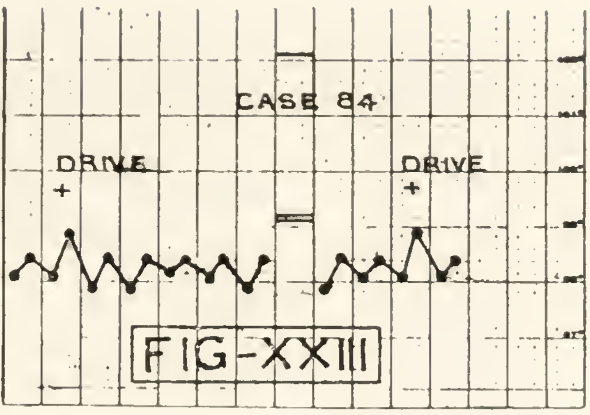


FIG - XXII



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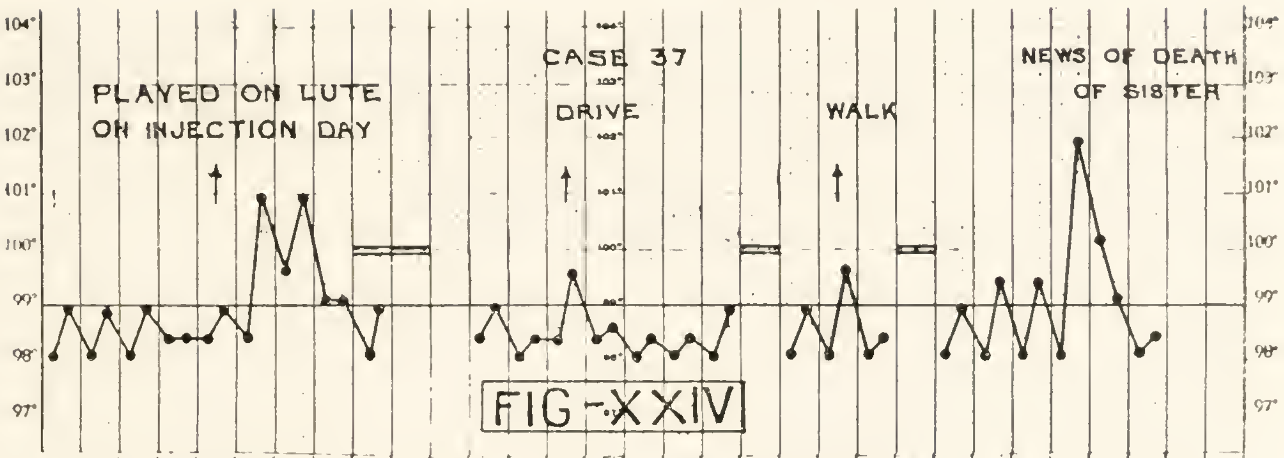
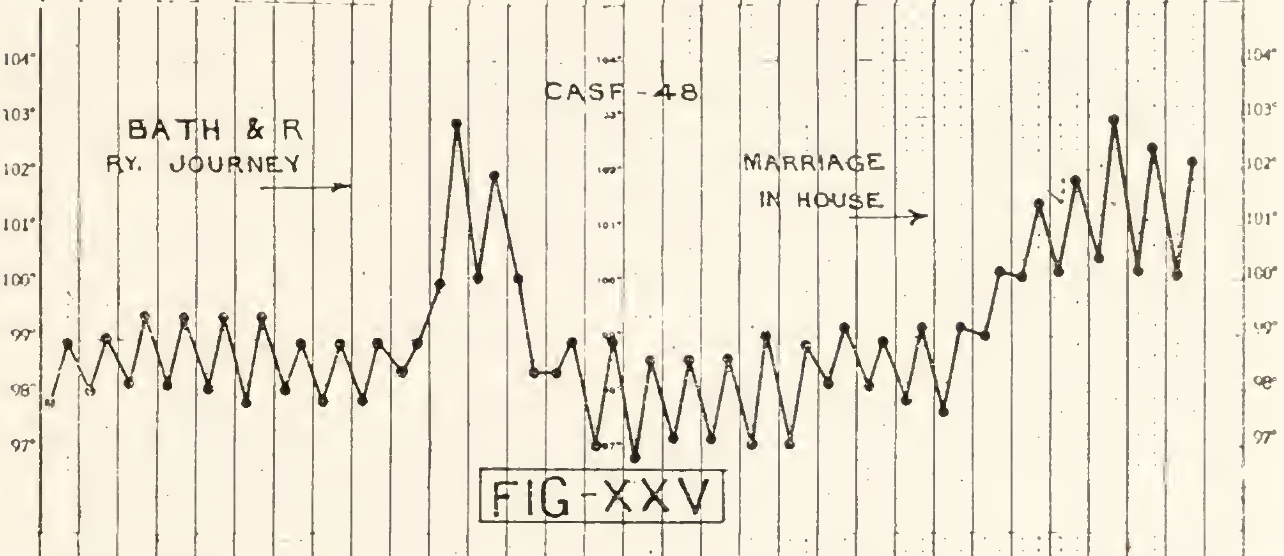


FIG-XXIV



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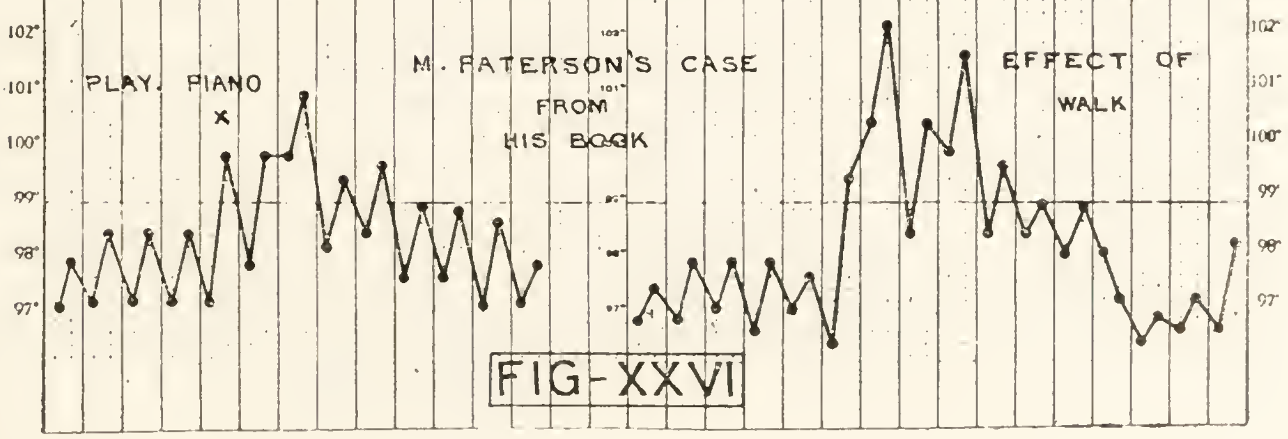

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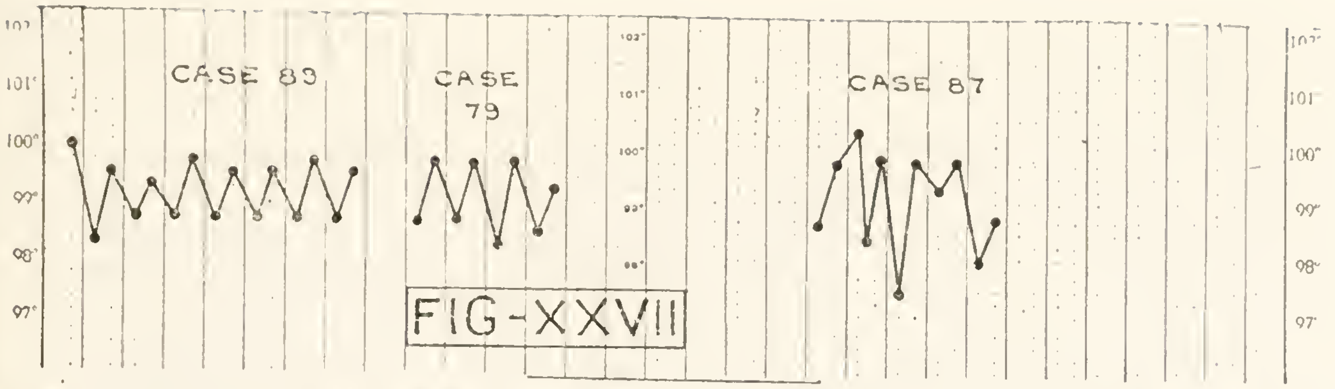

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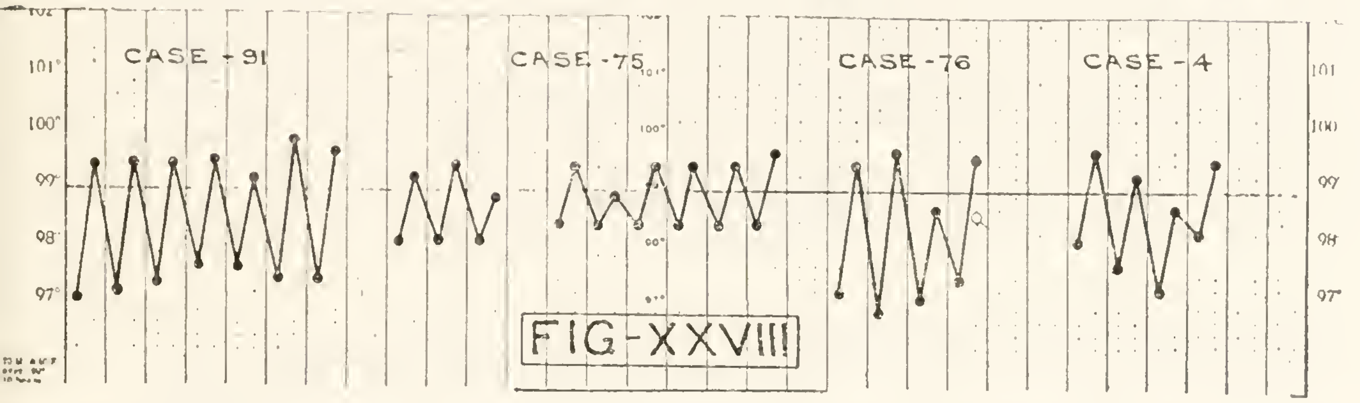

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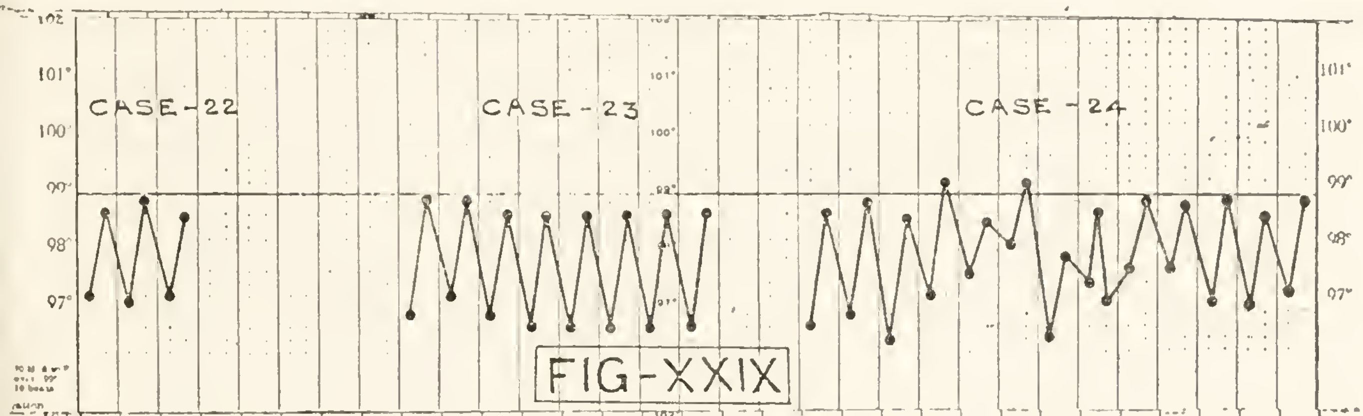

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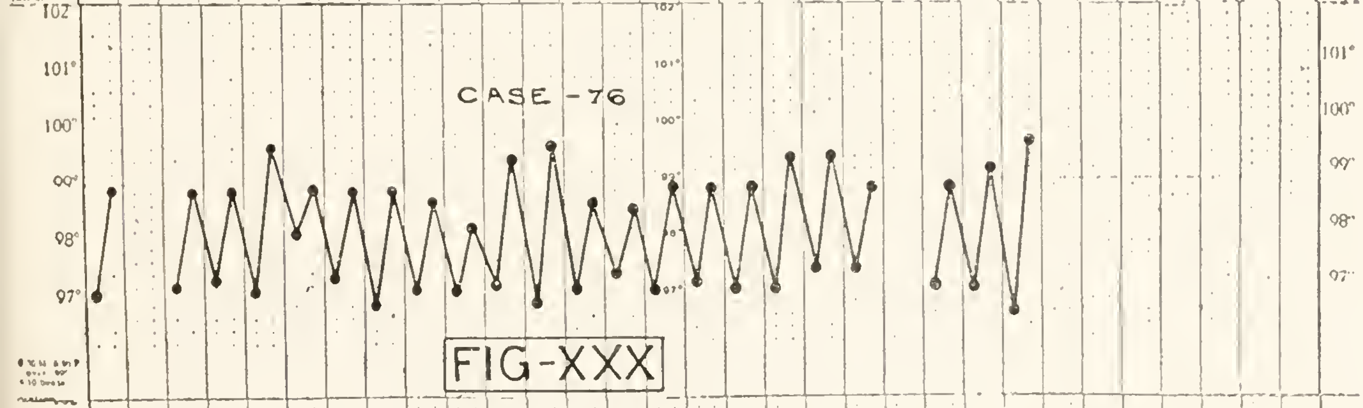


FIG-XXX

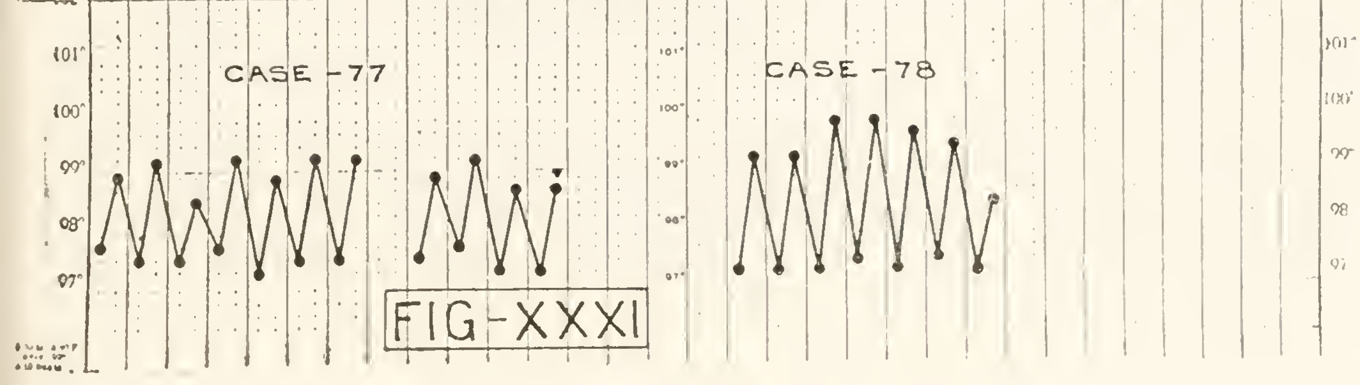


FIG-XXXI

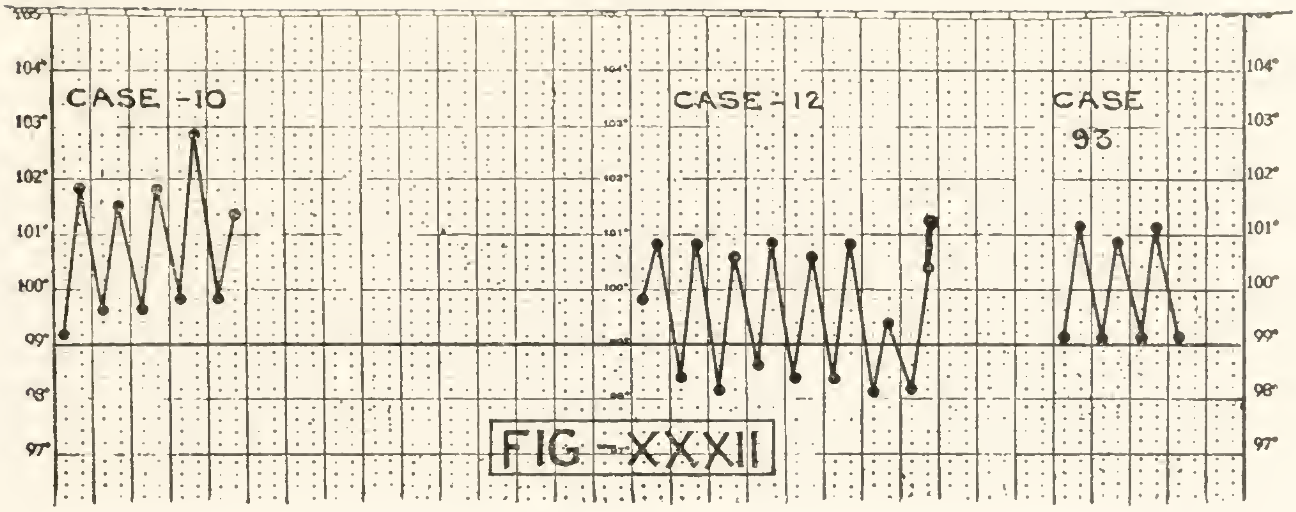


FIG - XXXII

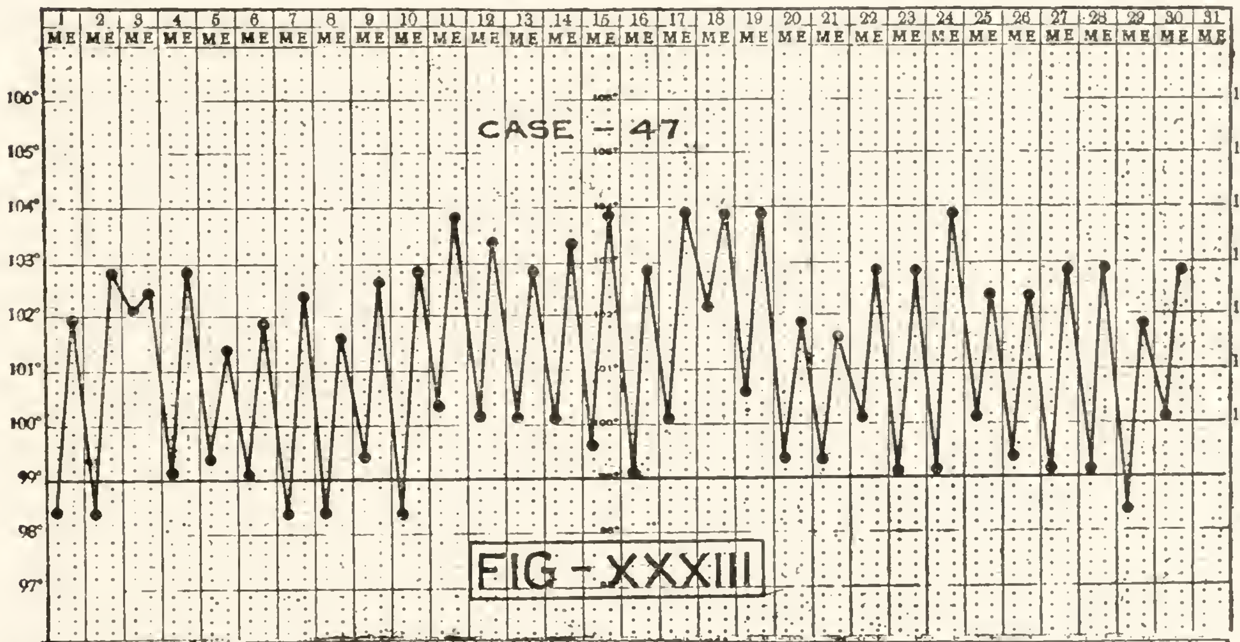


FIG - XXXIII

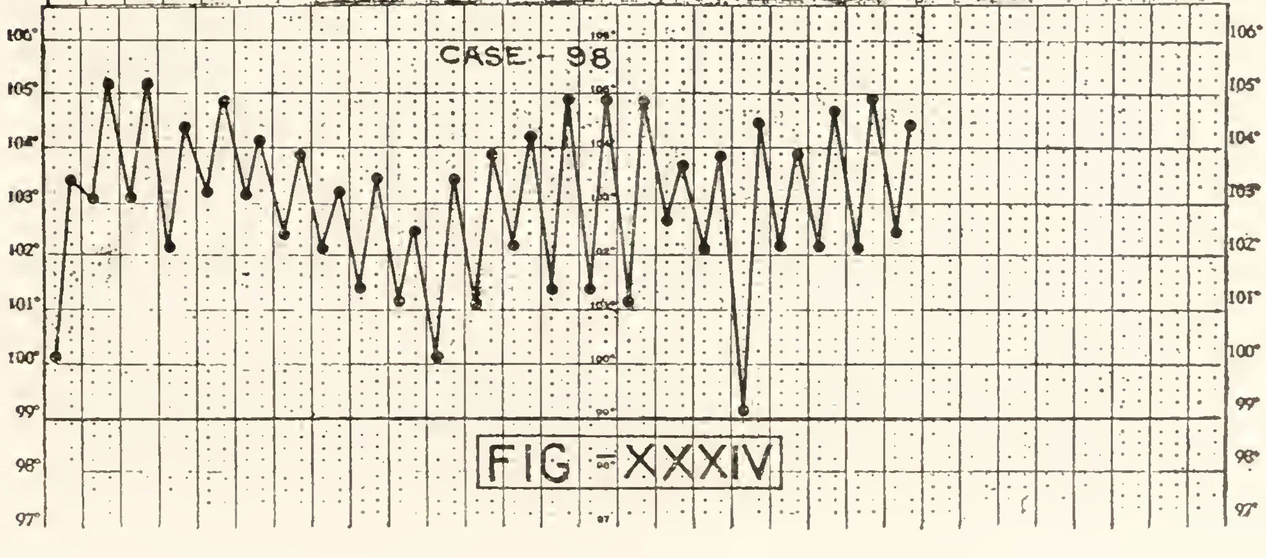


FIG - XXXIV

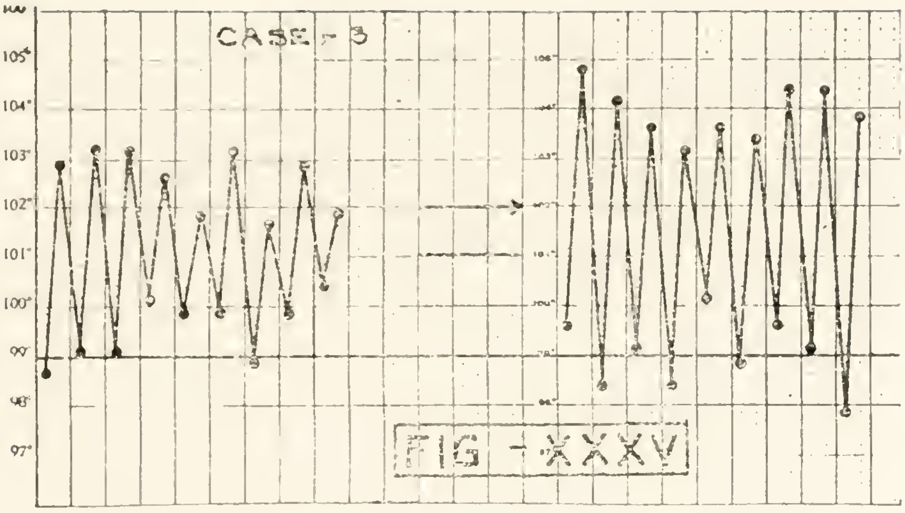


FIG - XXXV

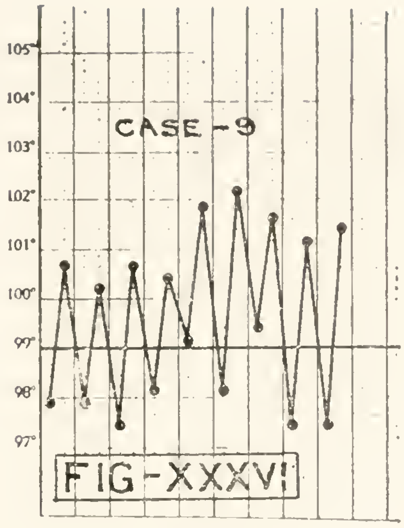
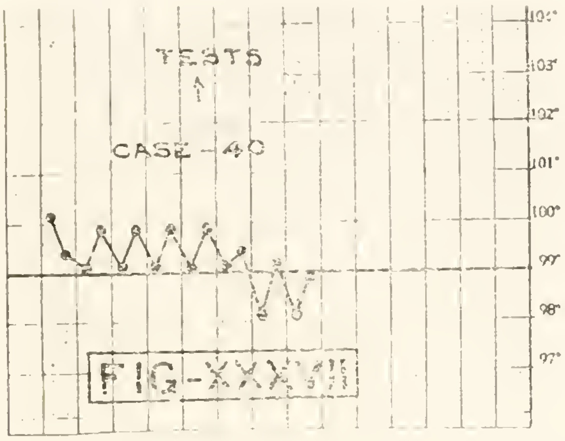


FIG - XXXVI



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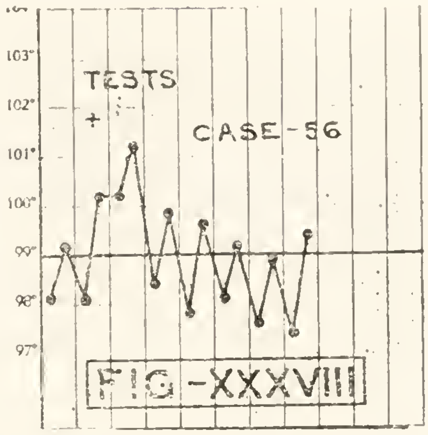

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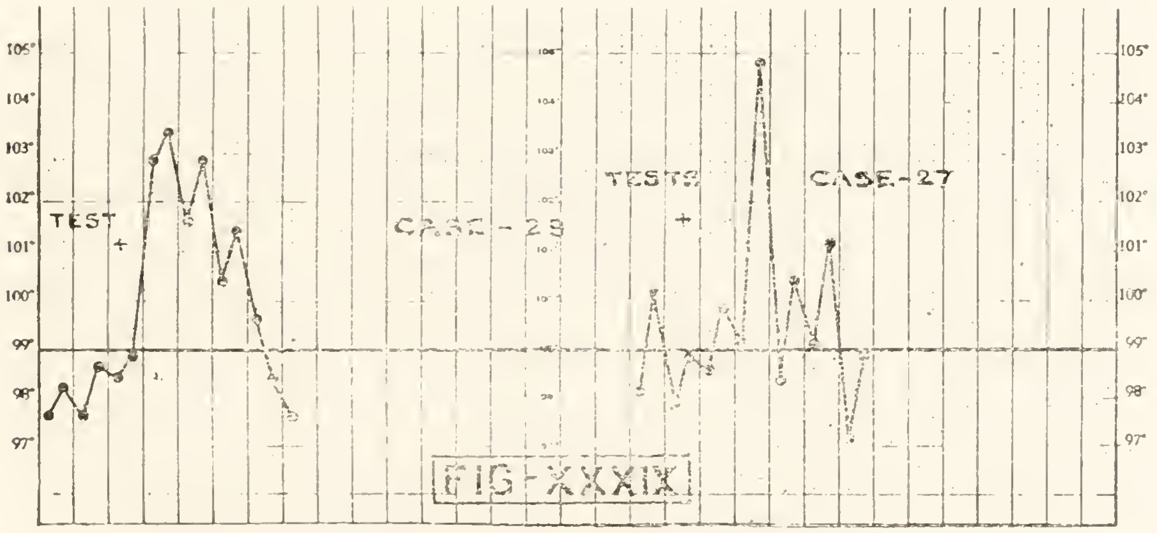

FIG - XXXIX

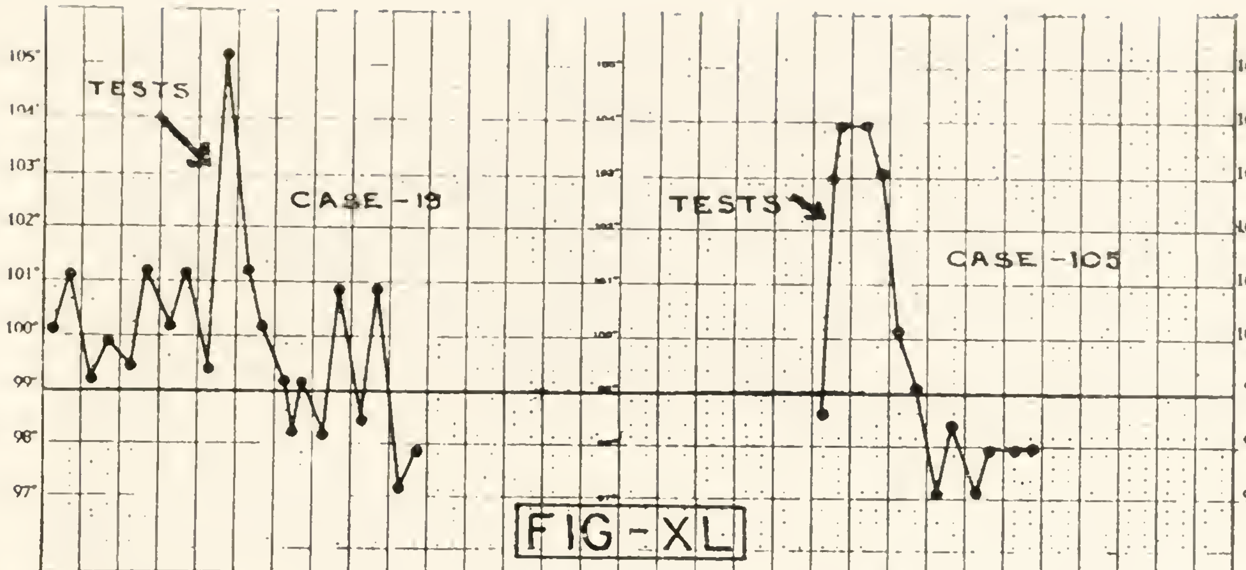

FIG - XL

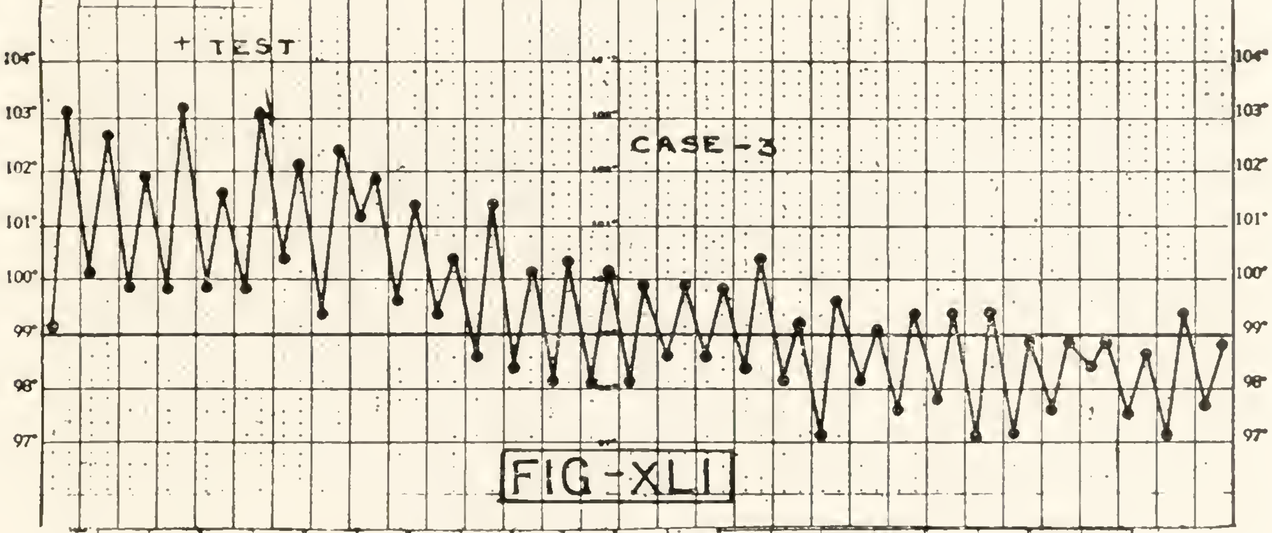

FIG - XLI

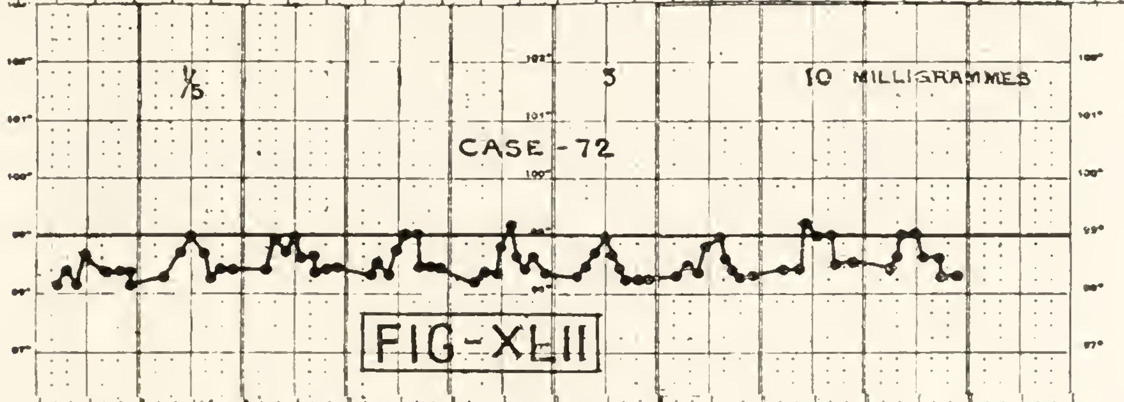

FIG - XLII

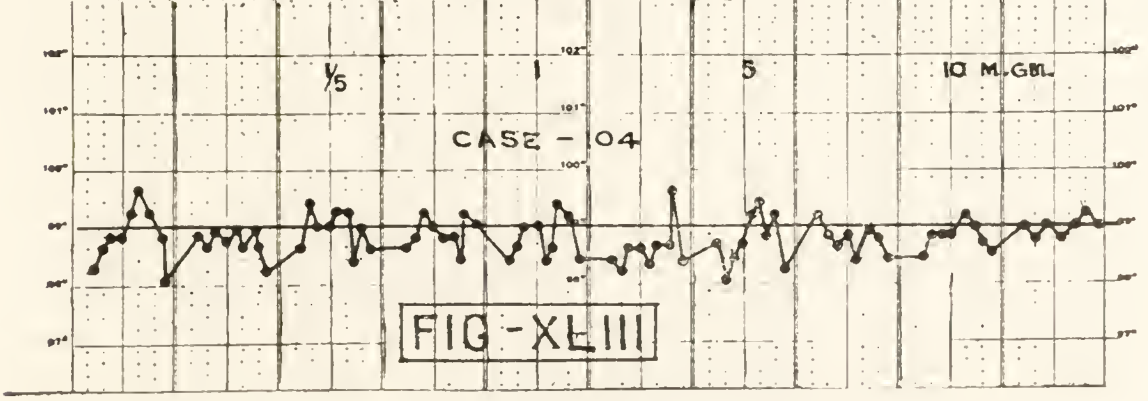

FIG - XLIII

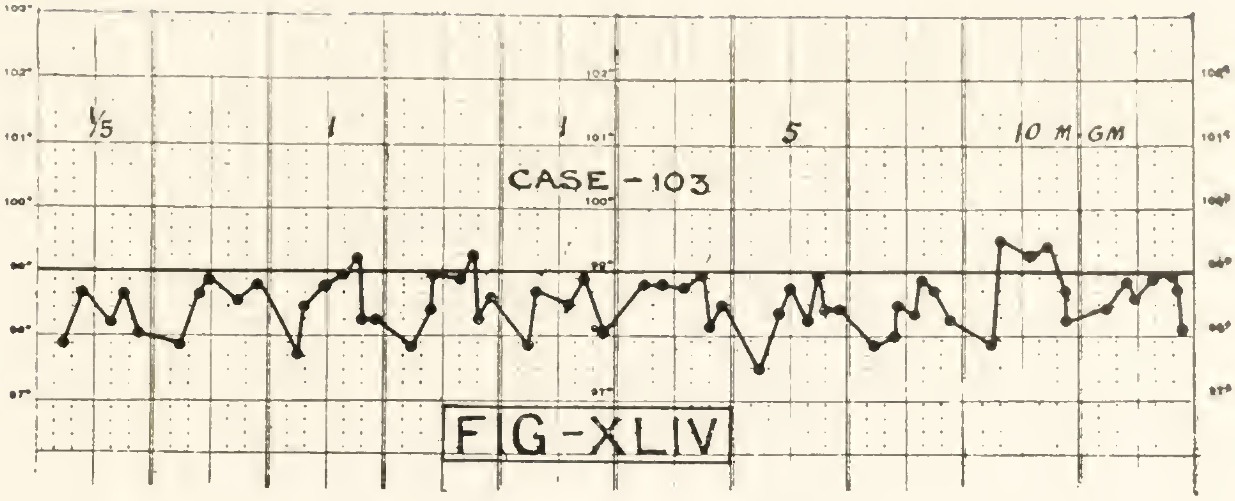

FIG-XLIV

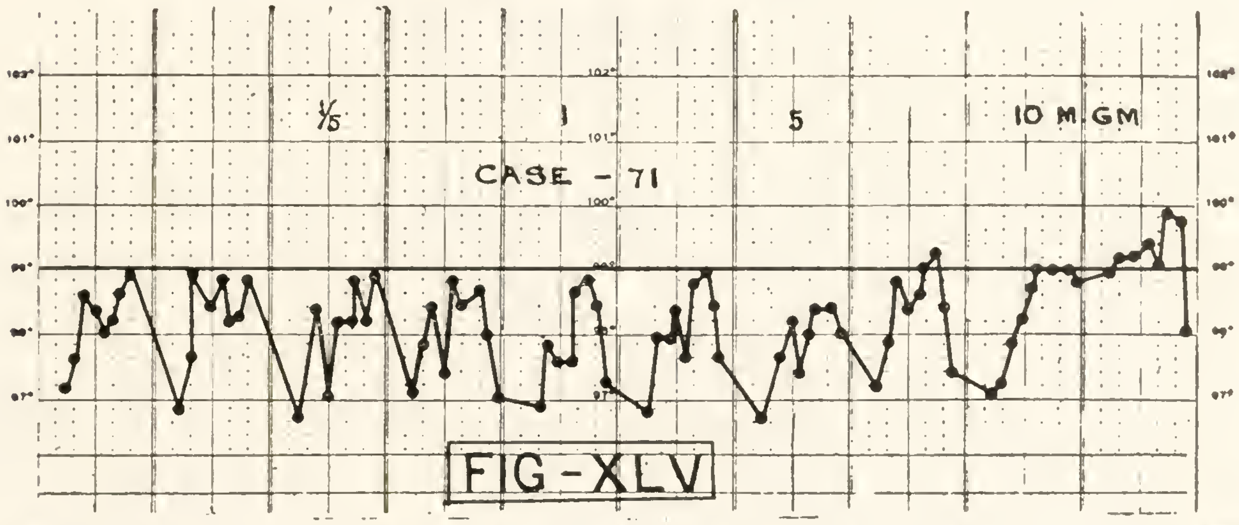

FIG-XLV

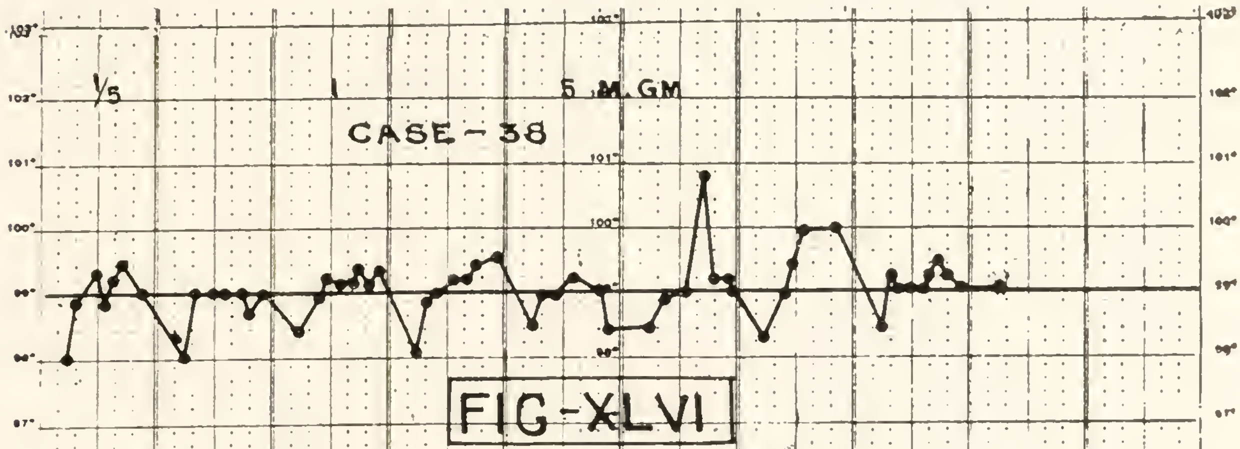

FIG-XLVI

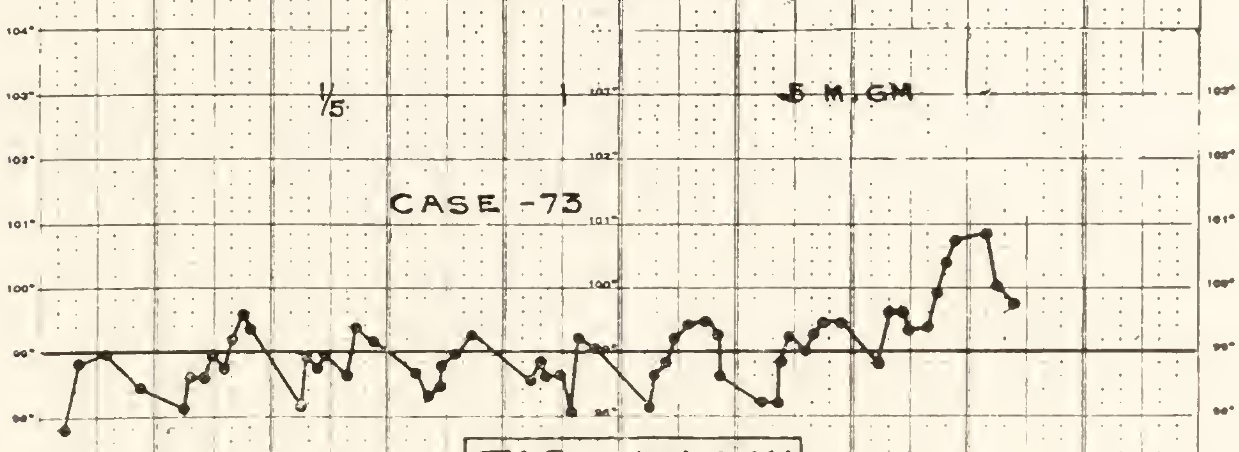

FIG-XLVII

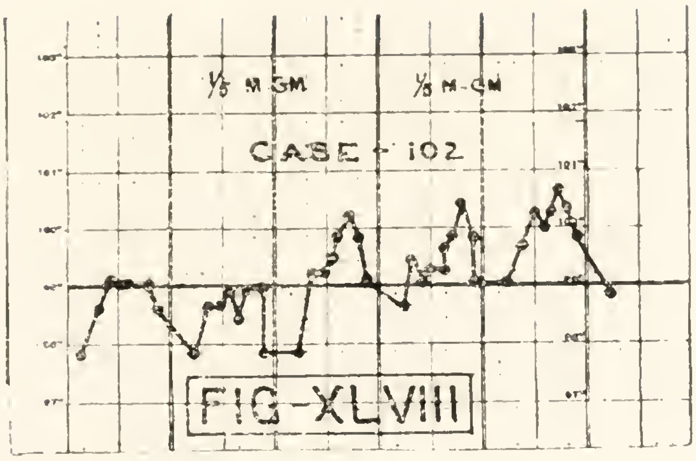

FIG-XLVIII

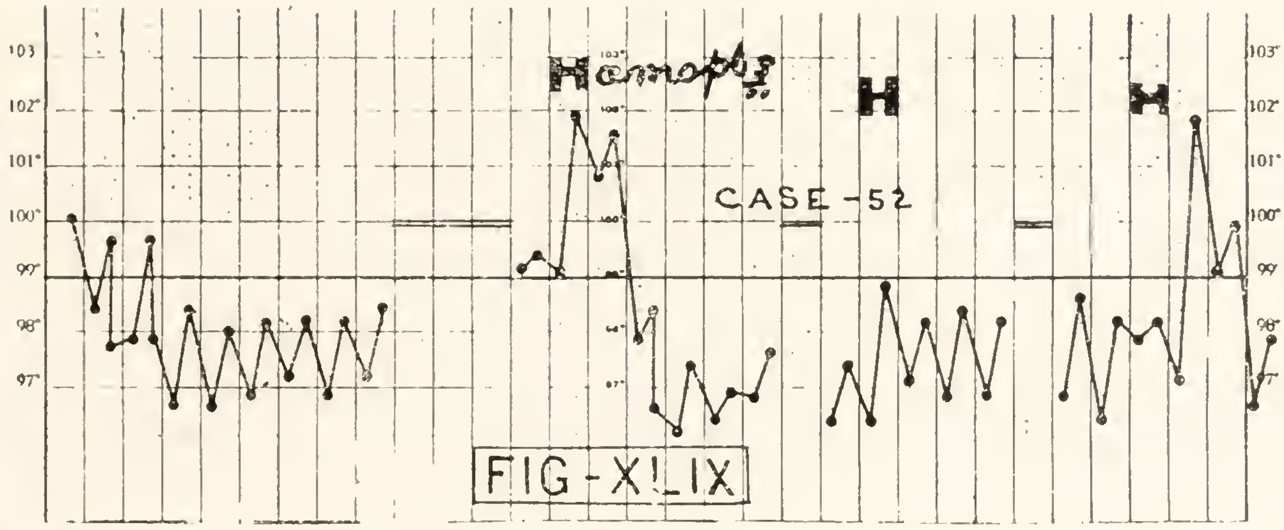

FIG-X'LIX

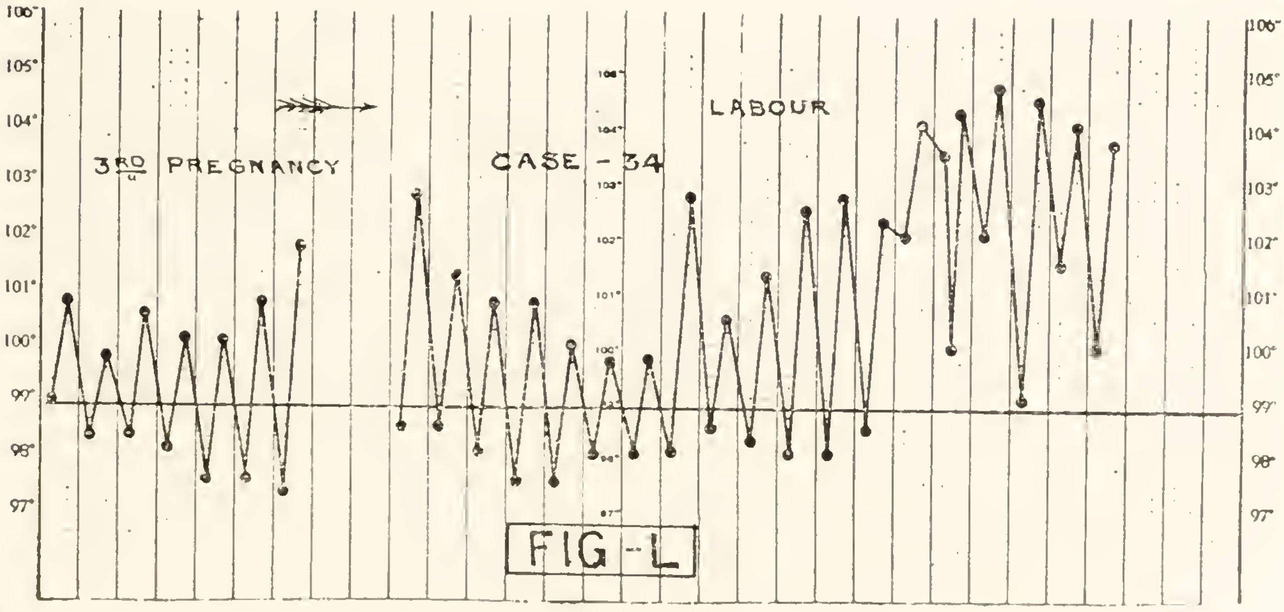

FIG-L

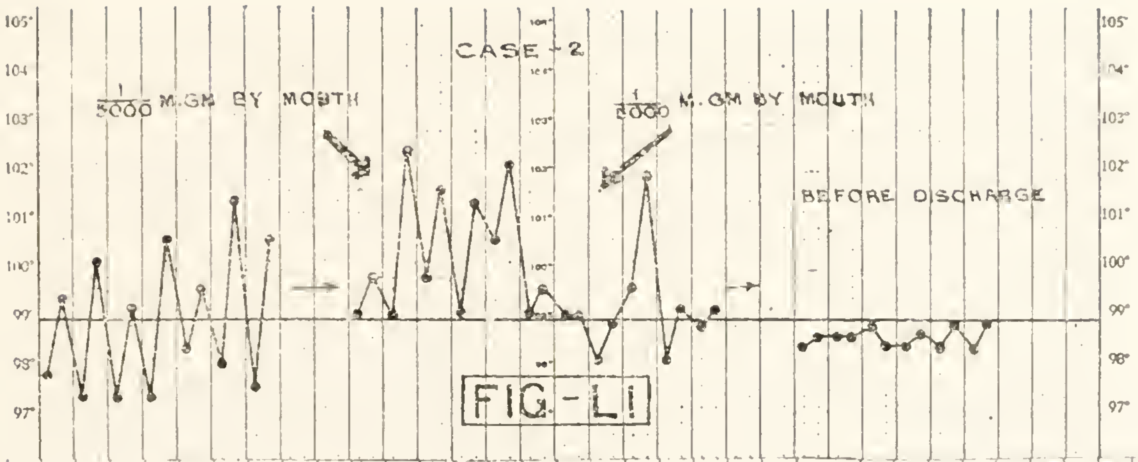

FIG - LI

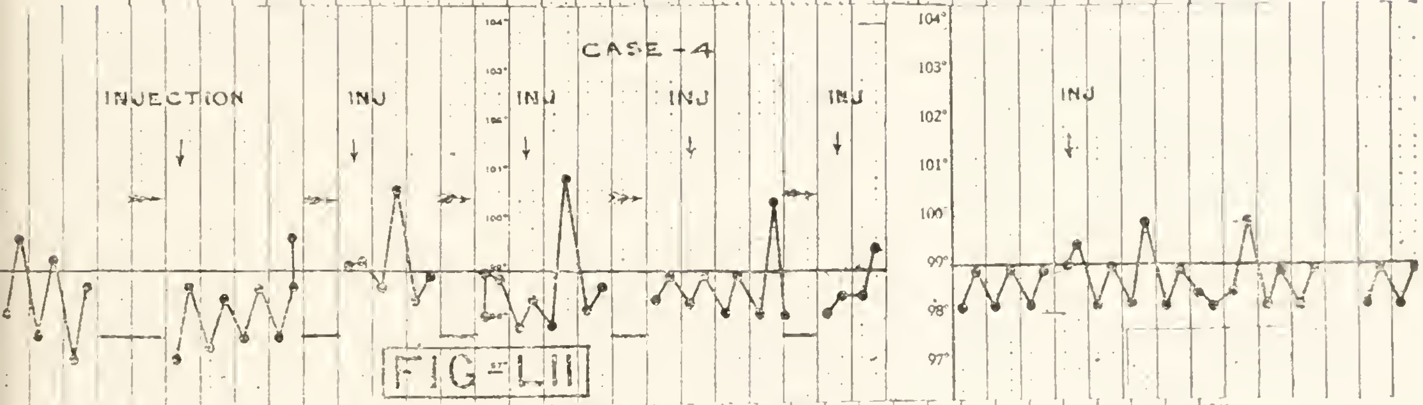

FIG - LII

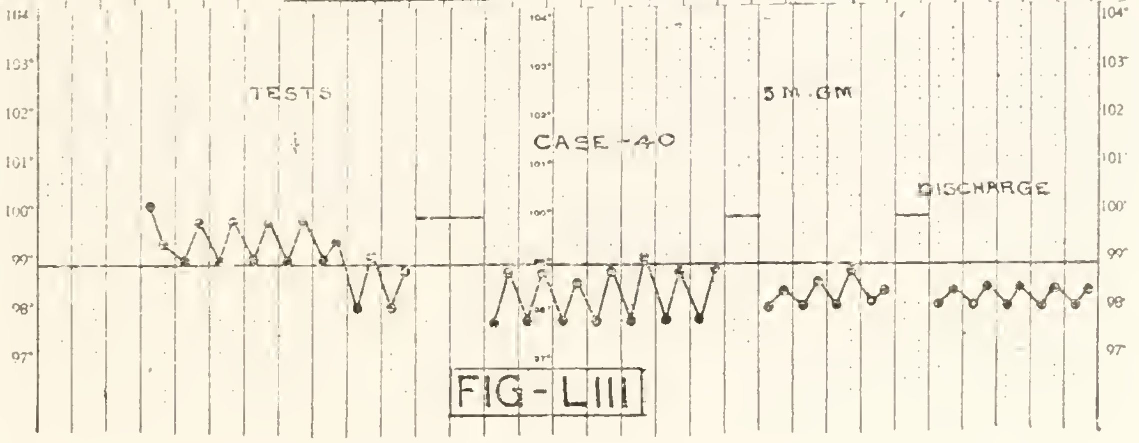

FIG - LIII

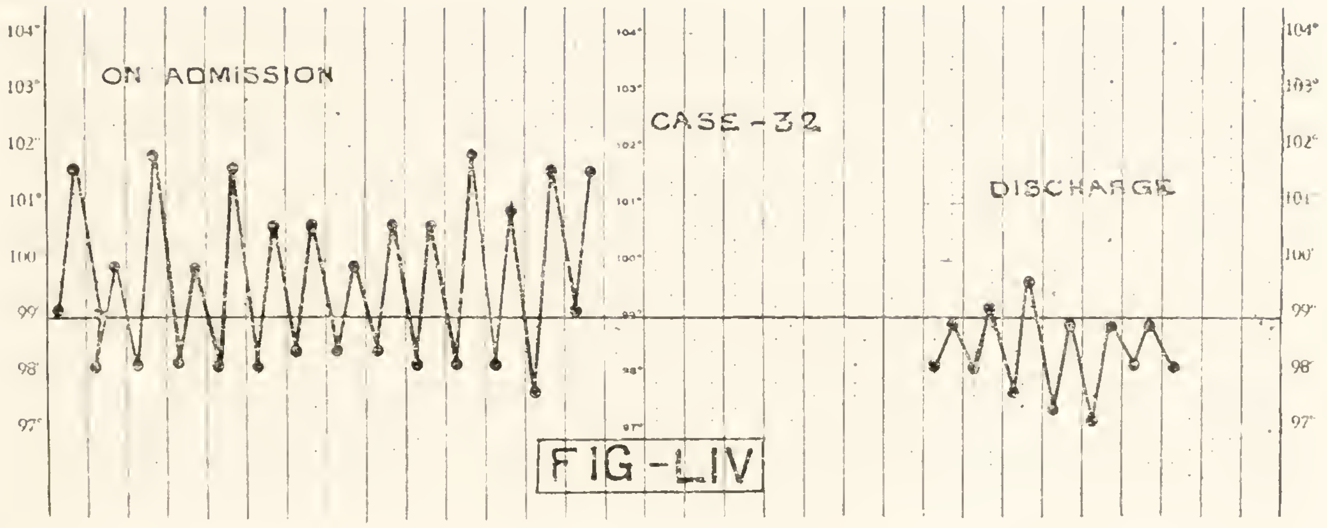

FIG - LIV

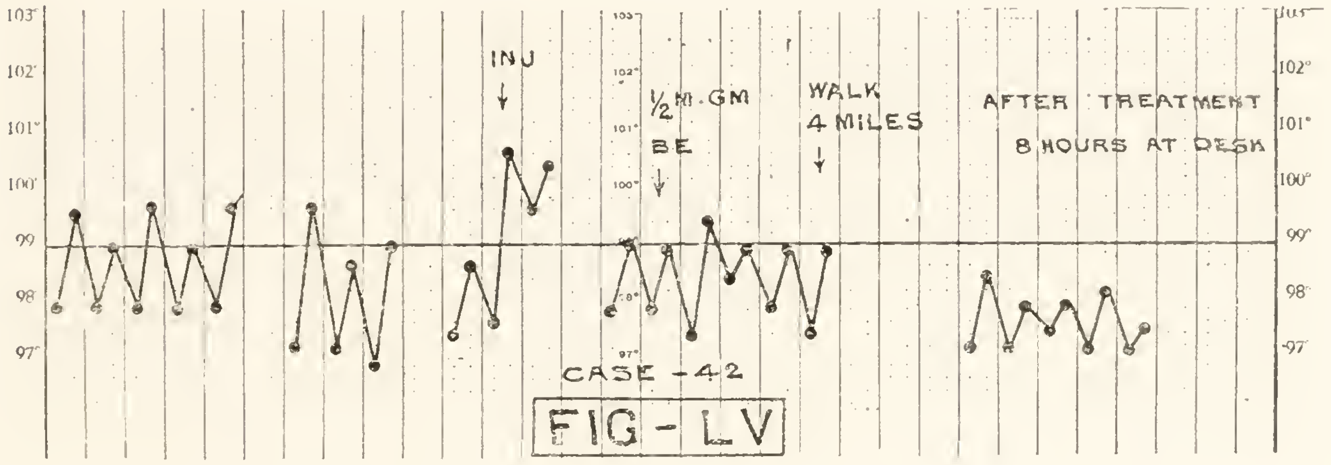

FIG - LV

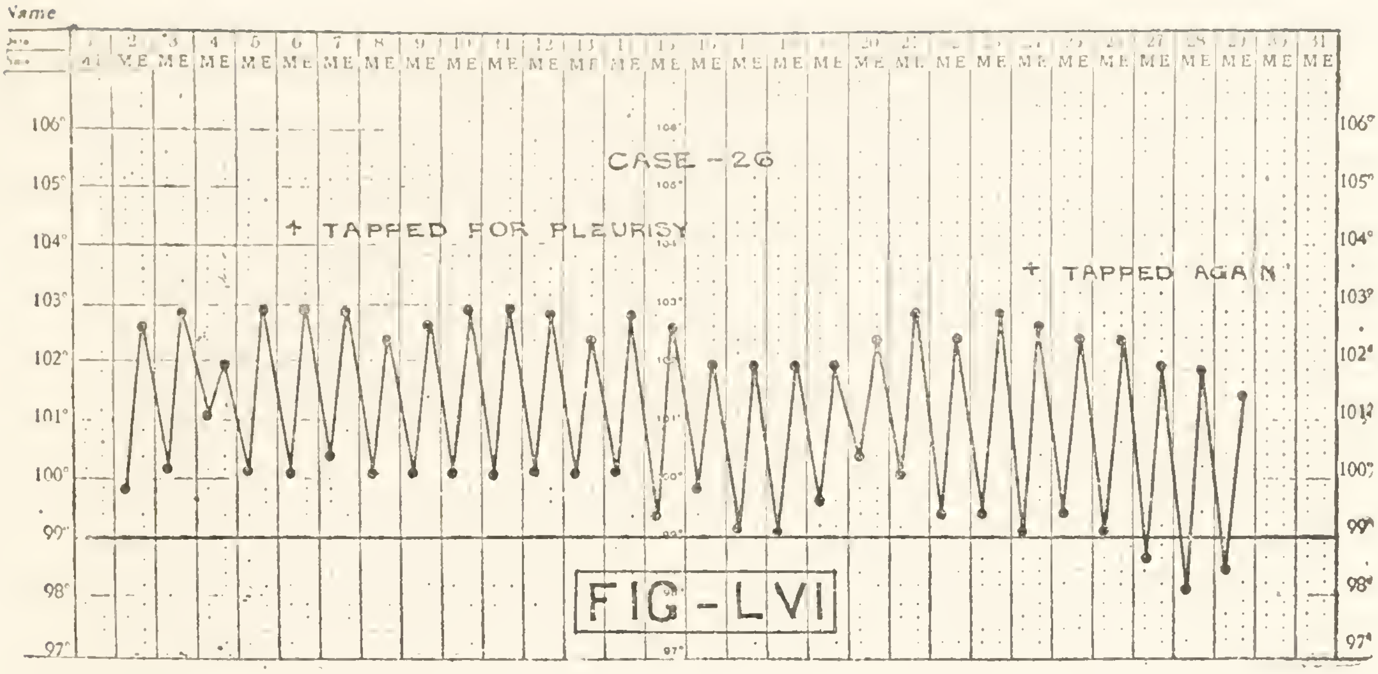

FIG - LVI

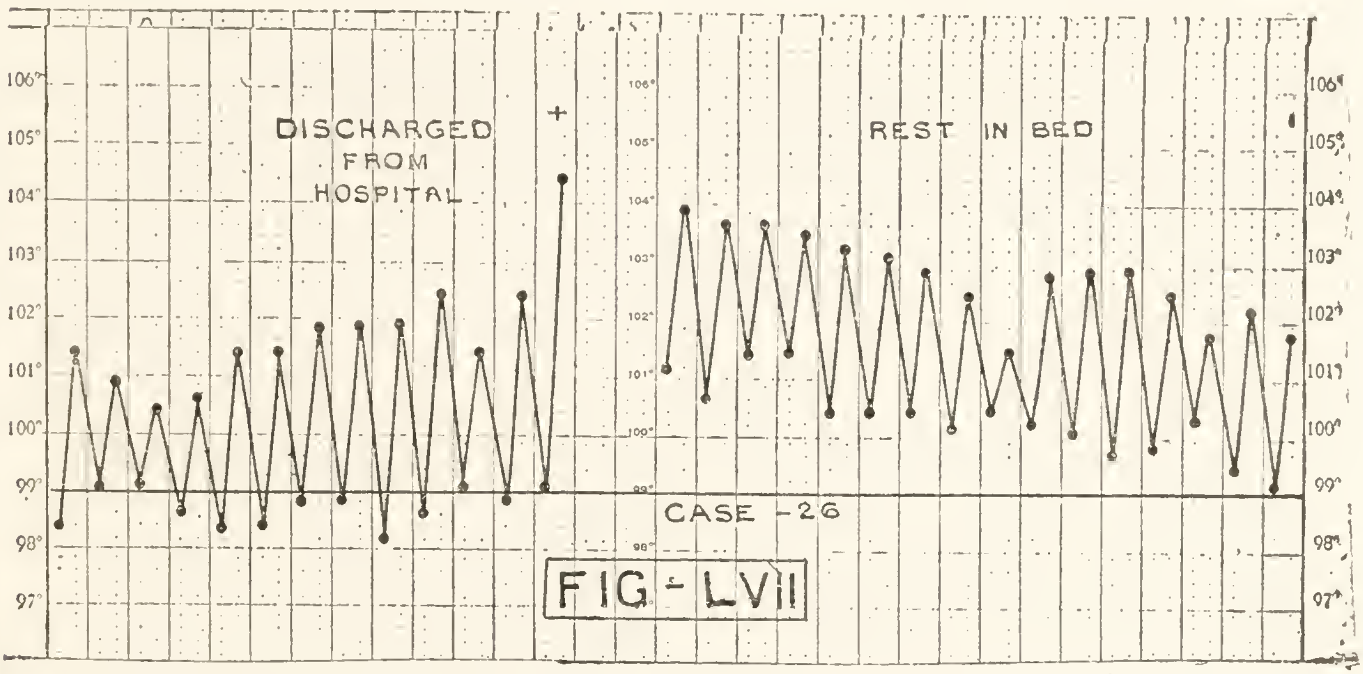

FIG - LVII

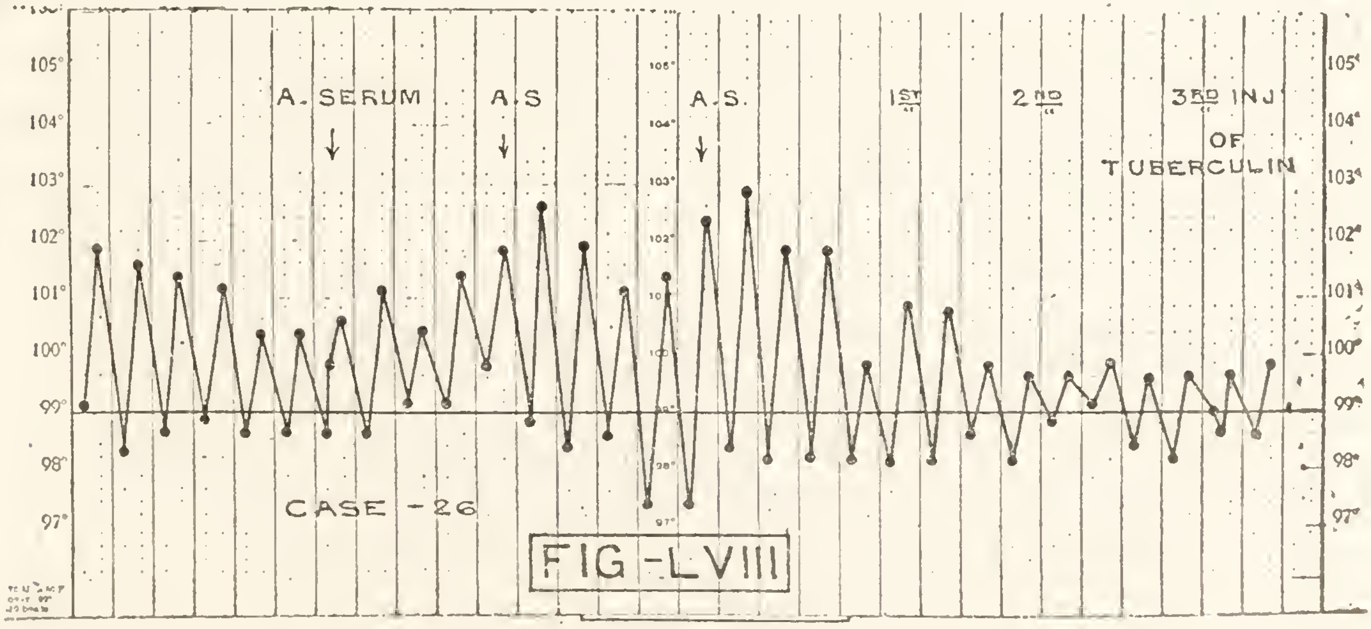

FIG - LVIII

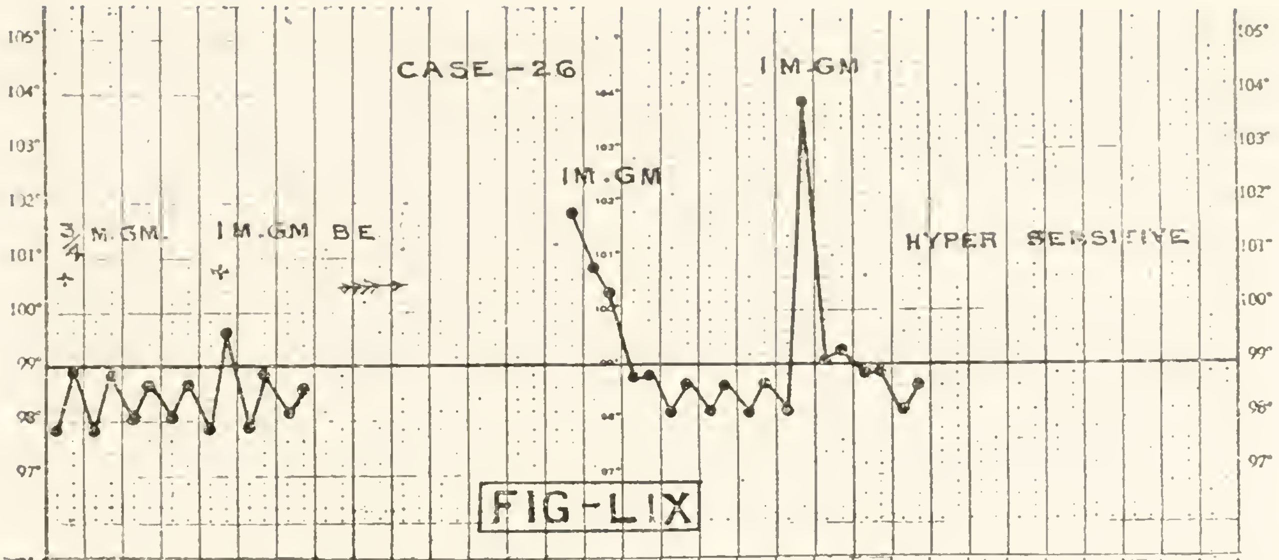

FIG - LIX

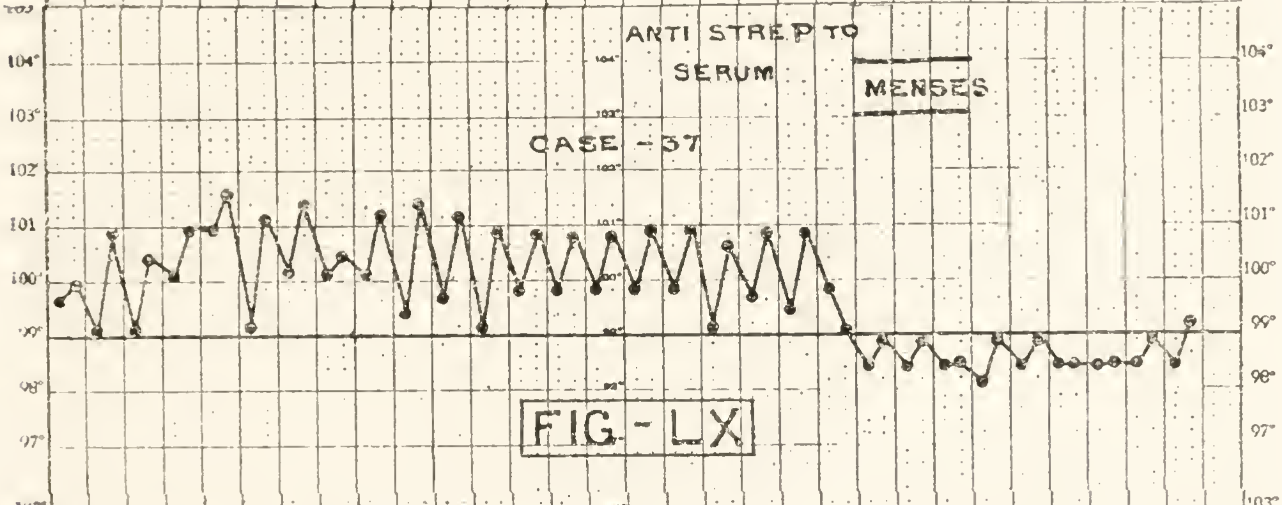

FIG - LX

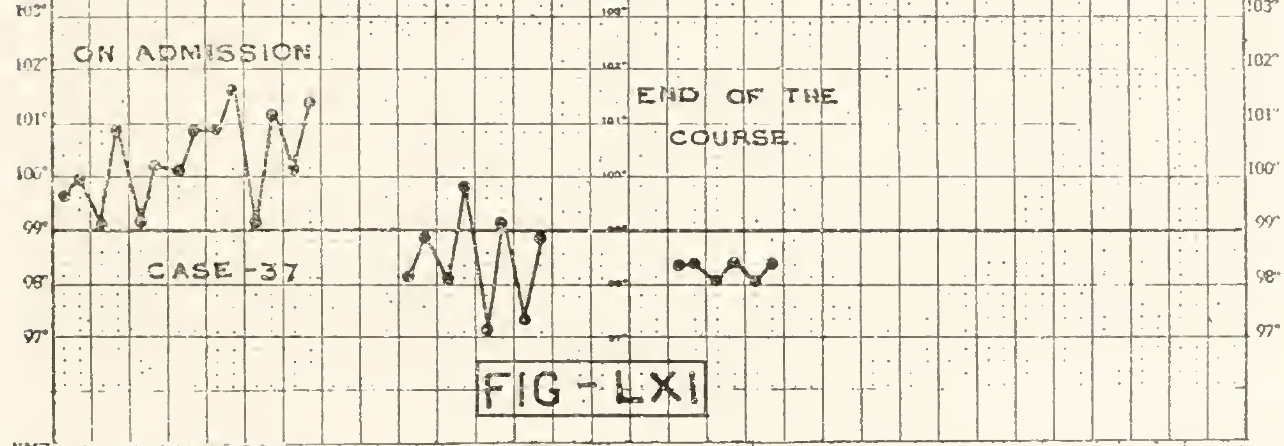

FIG - LXI

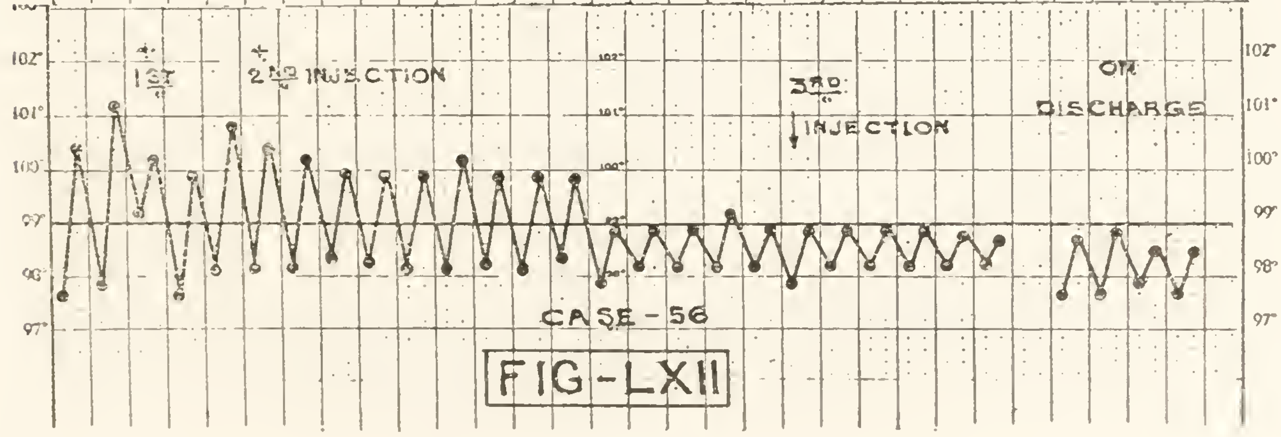

FIG - LXII

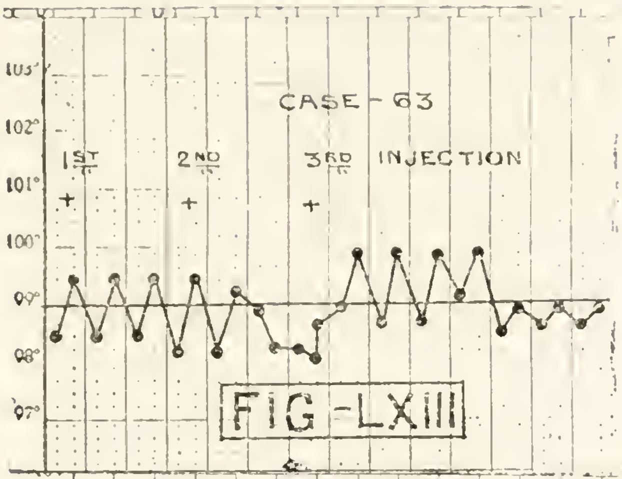

FIG - LXIII

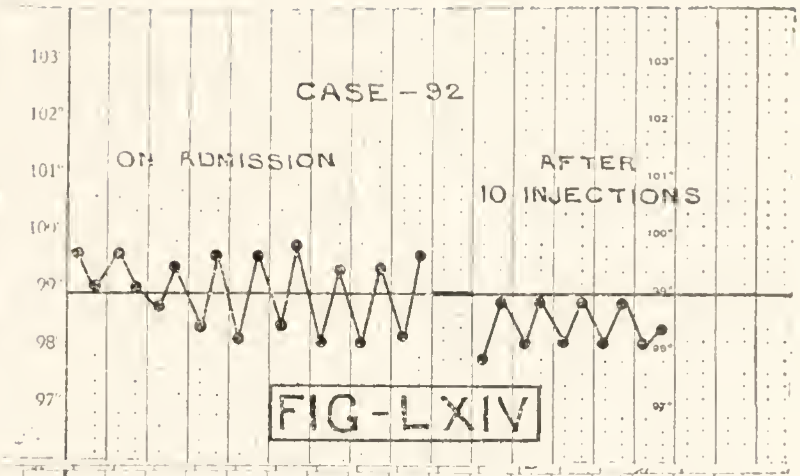

FIG - LXIV

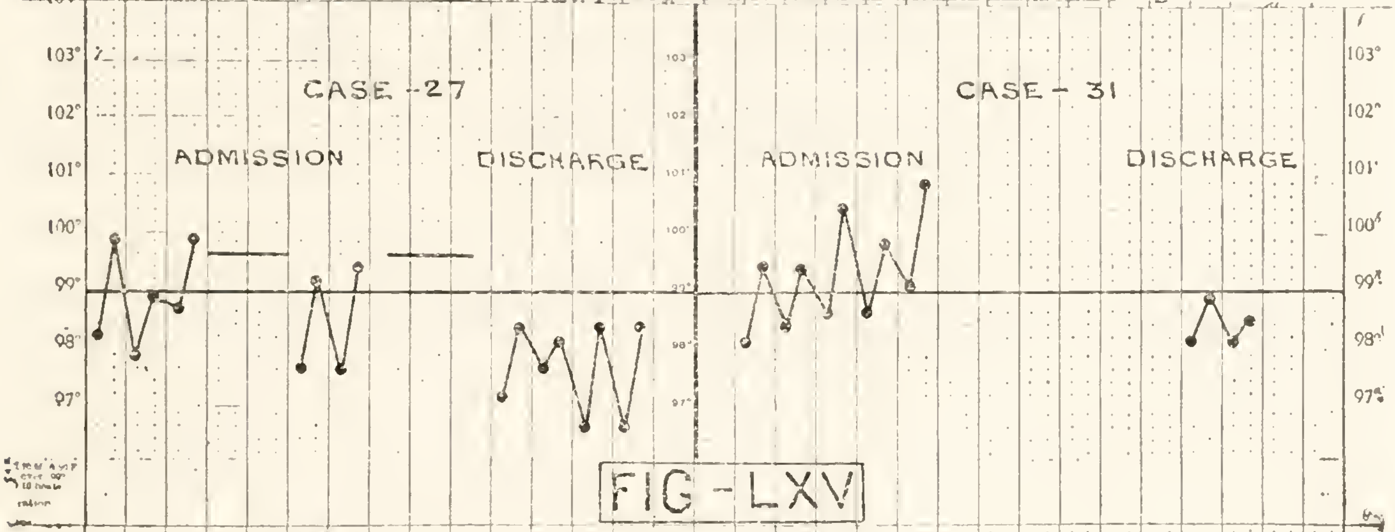

FIG - LXV

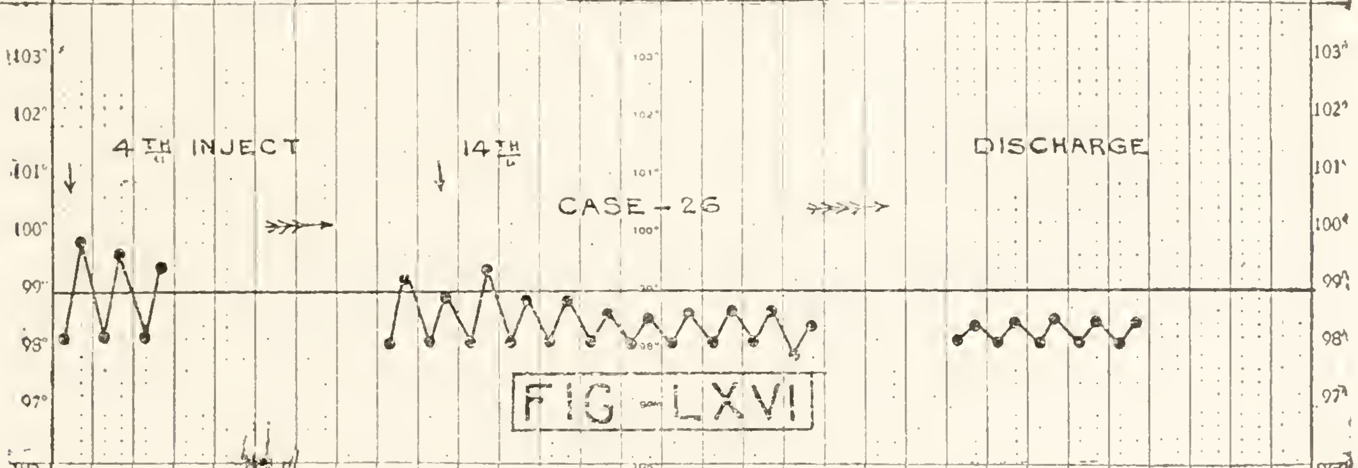

FIG - LXVI

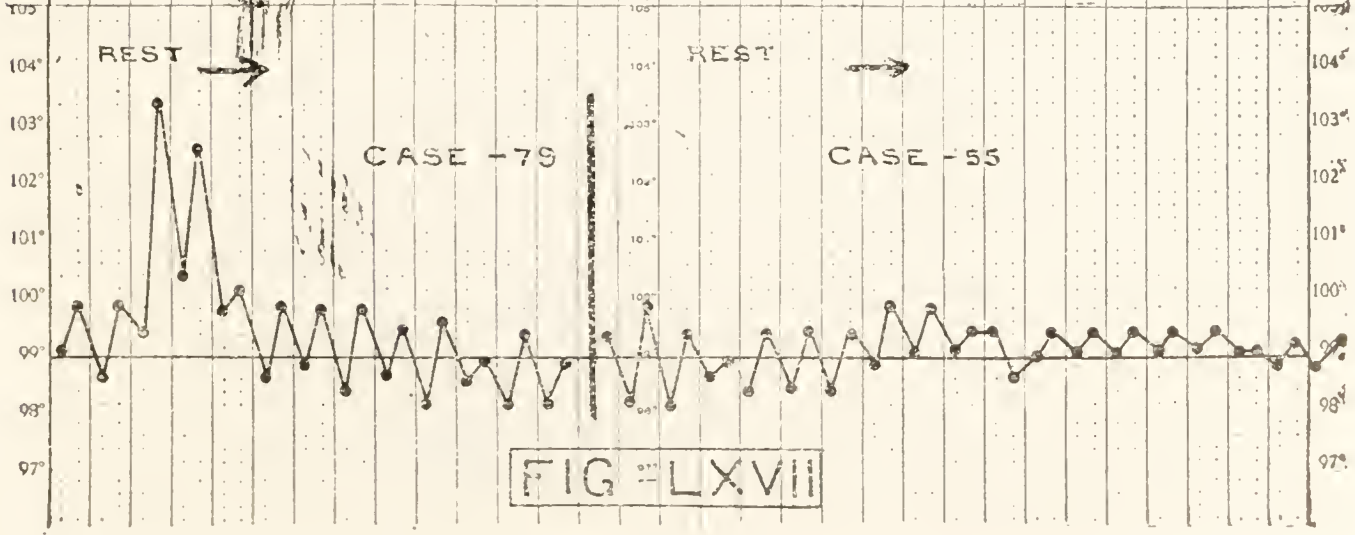

FIG - LXVII

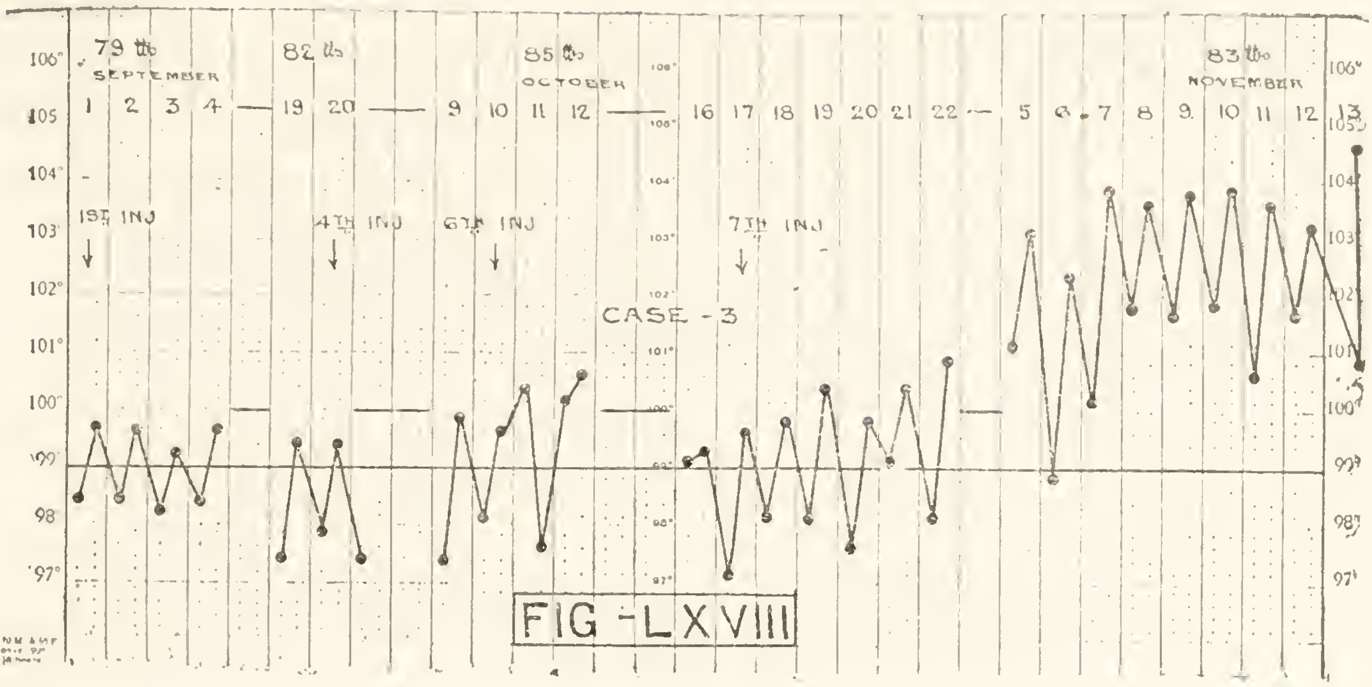

FIG - LXVIII

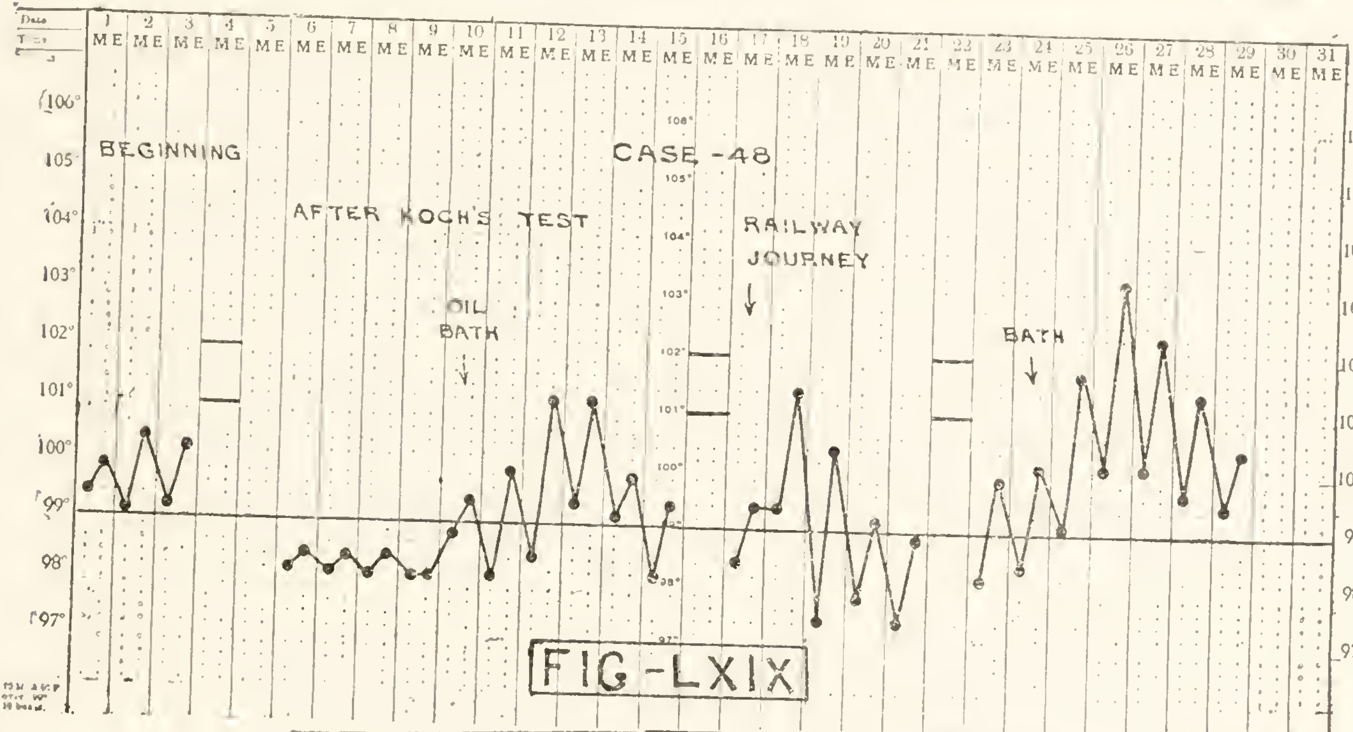

FIG - LXIX

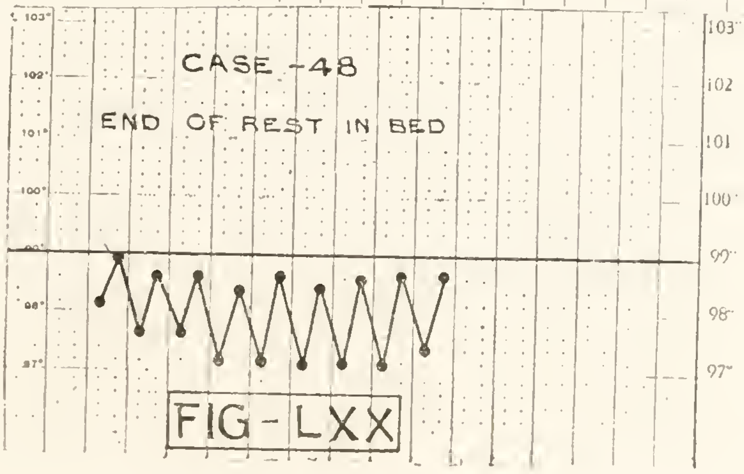

FIG - LXX

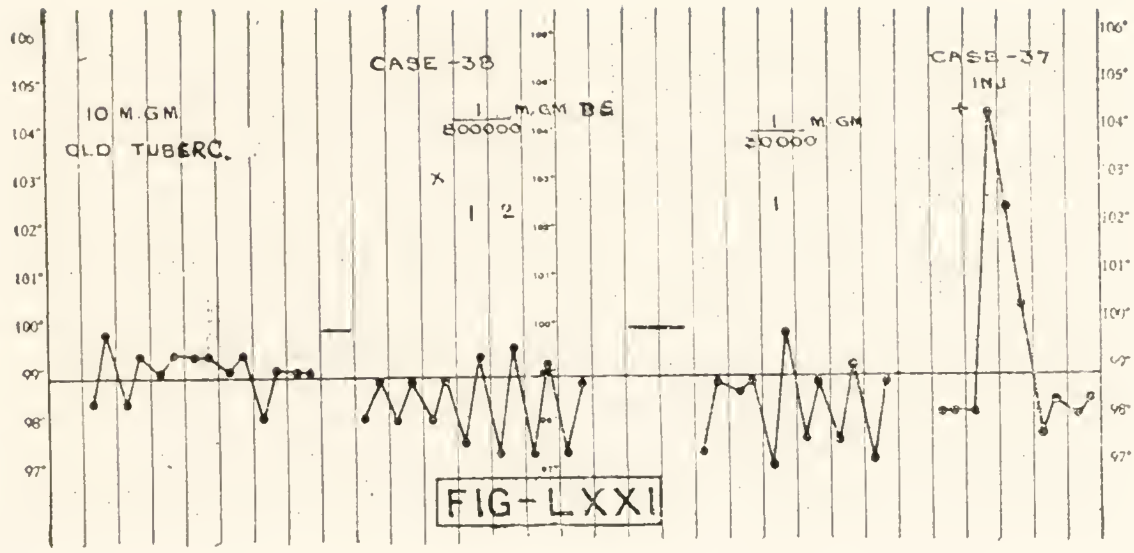

FIG-LXXI

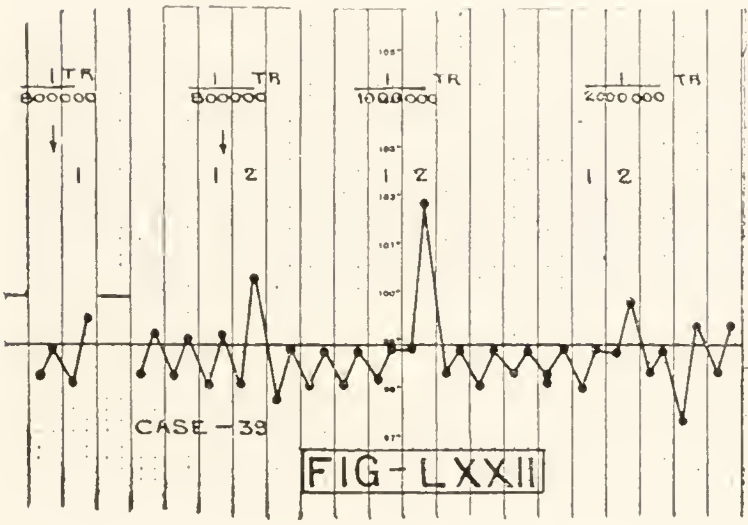

FIG-LXXII

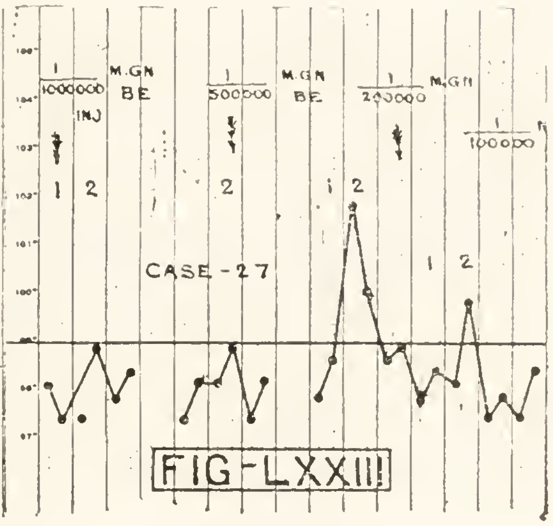

FIG-LXXIII

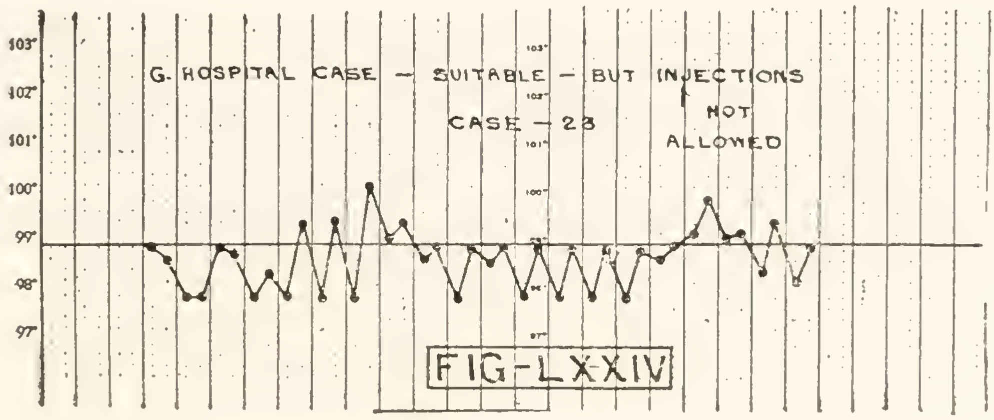

FIG-LXXIV

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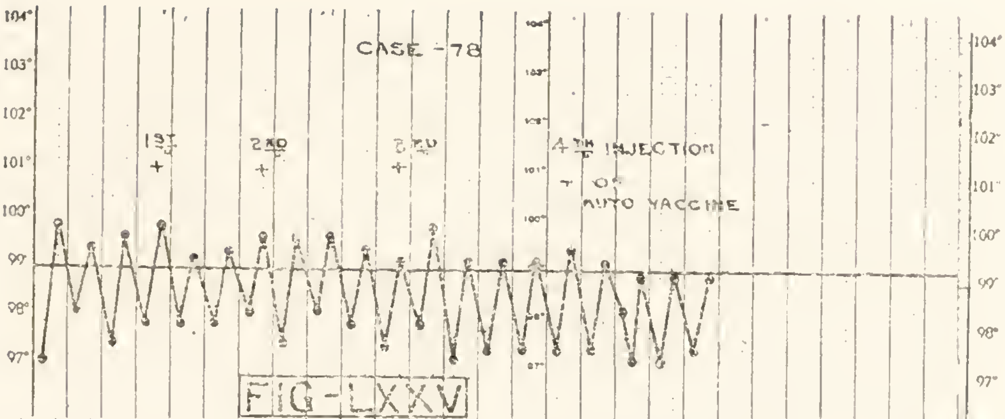

FIG - LXXV

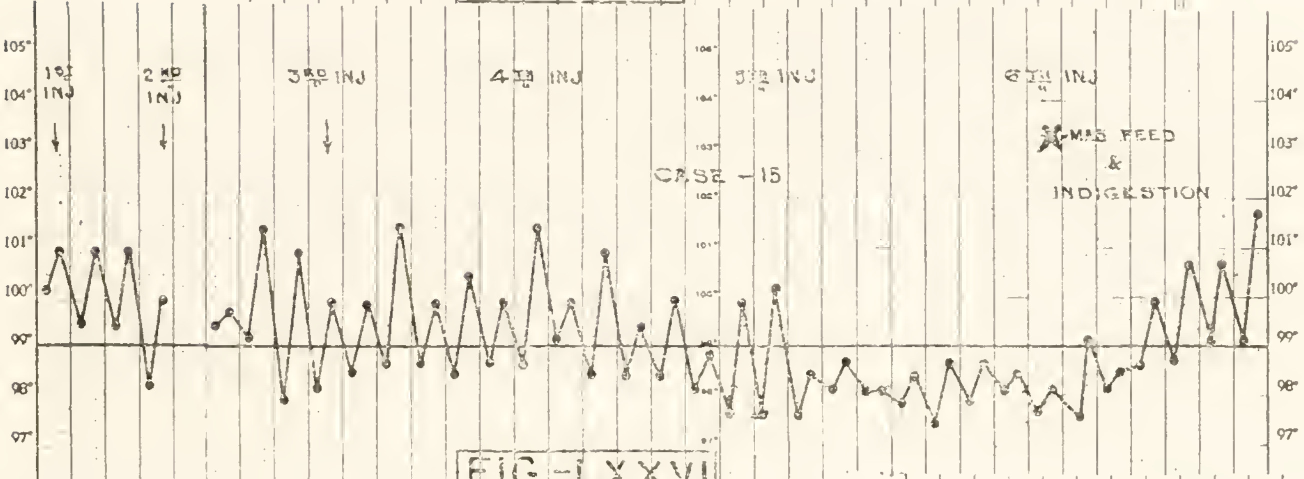

FIG - LXXVI

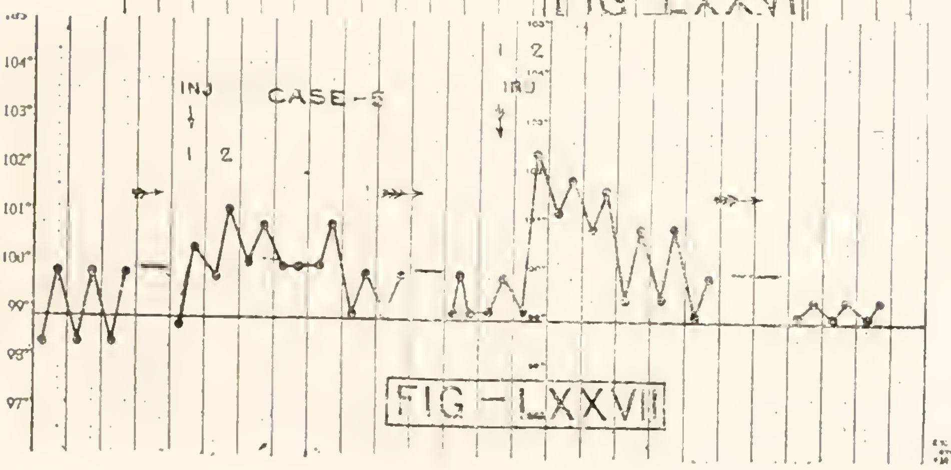

FIG - LXXVII

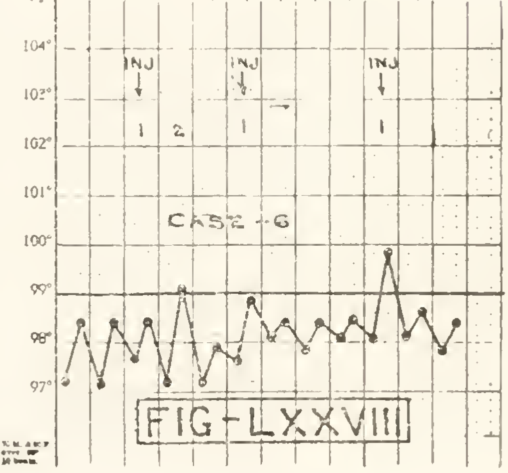

FIG - LXXVIII

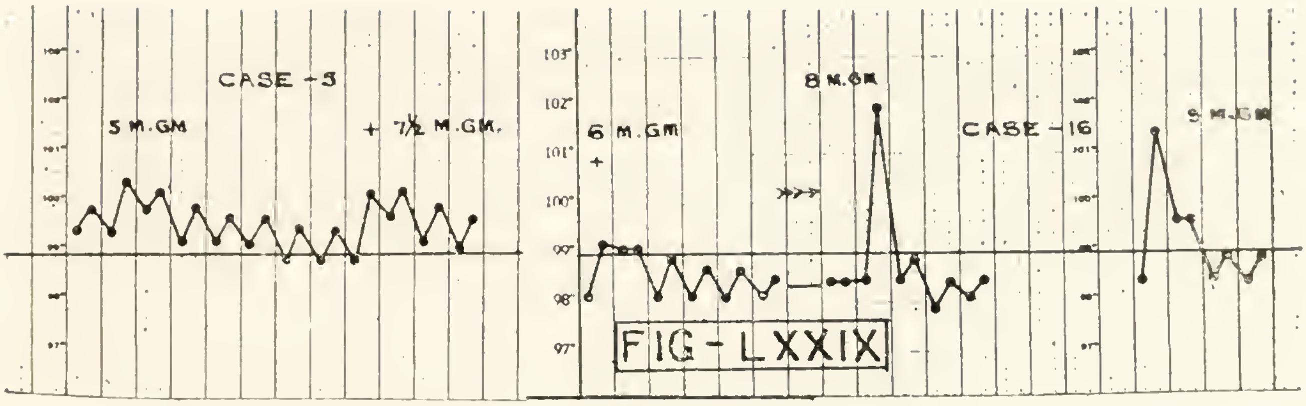

FIG - LXXIX

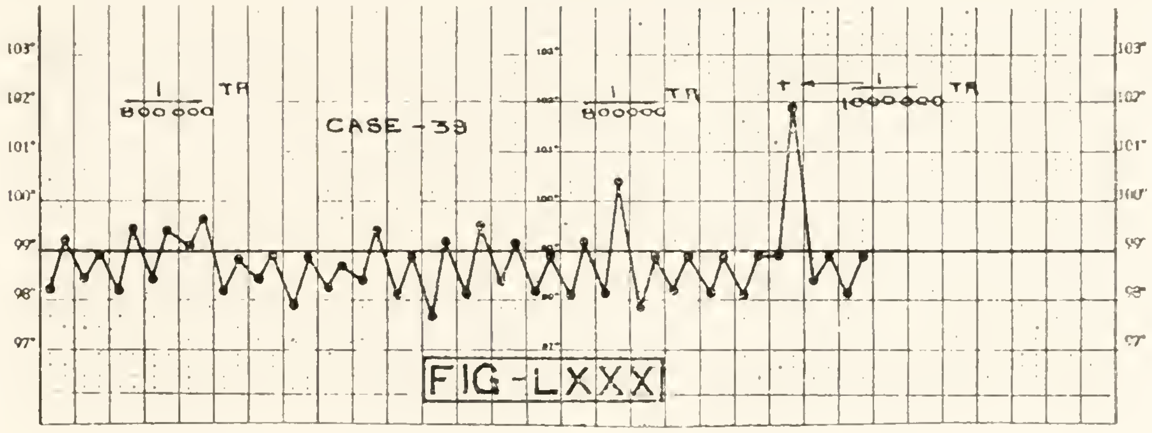

FIG - LXXX

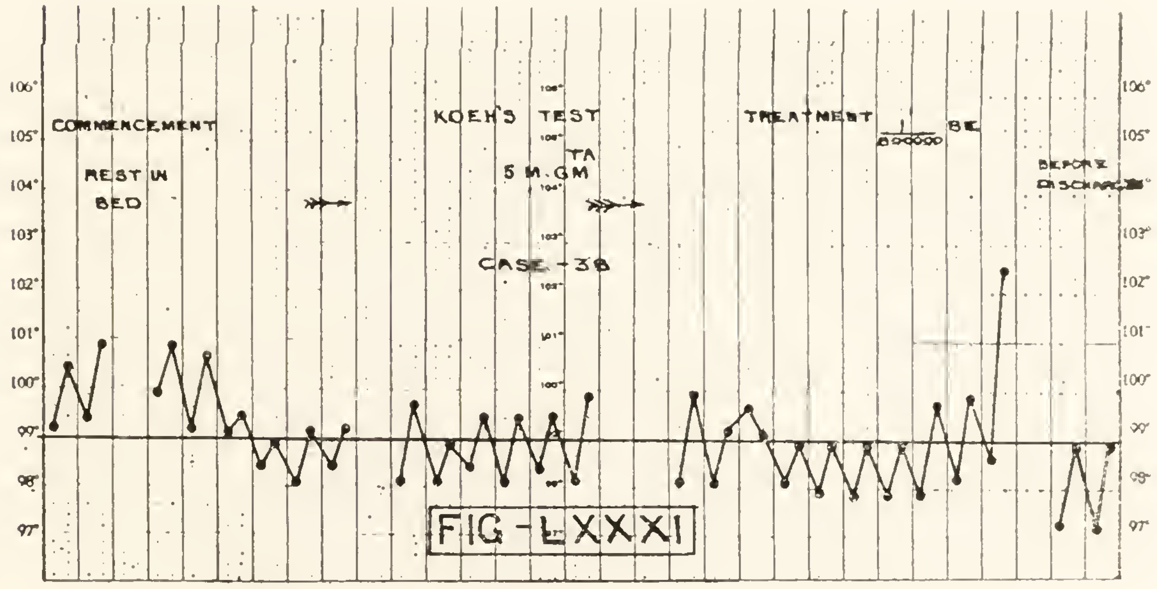

FIG - LXXXI

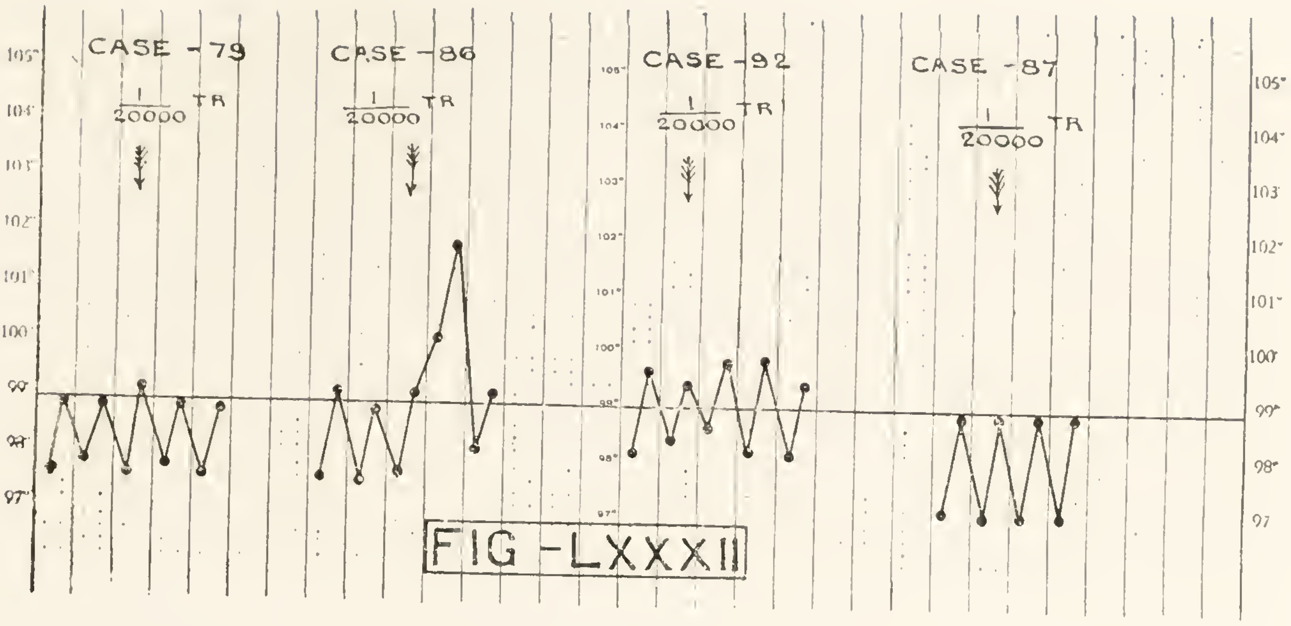

FIG - LXXXII

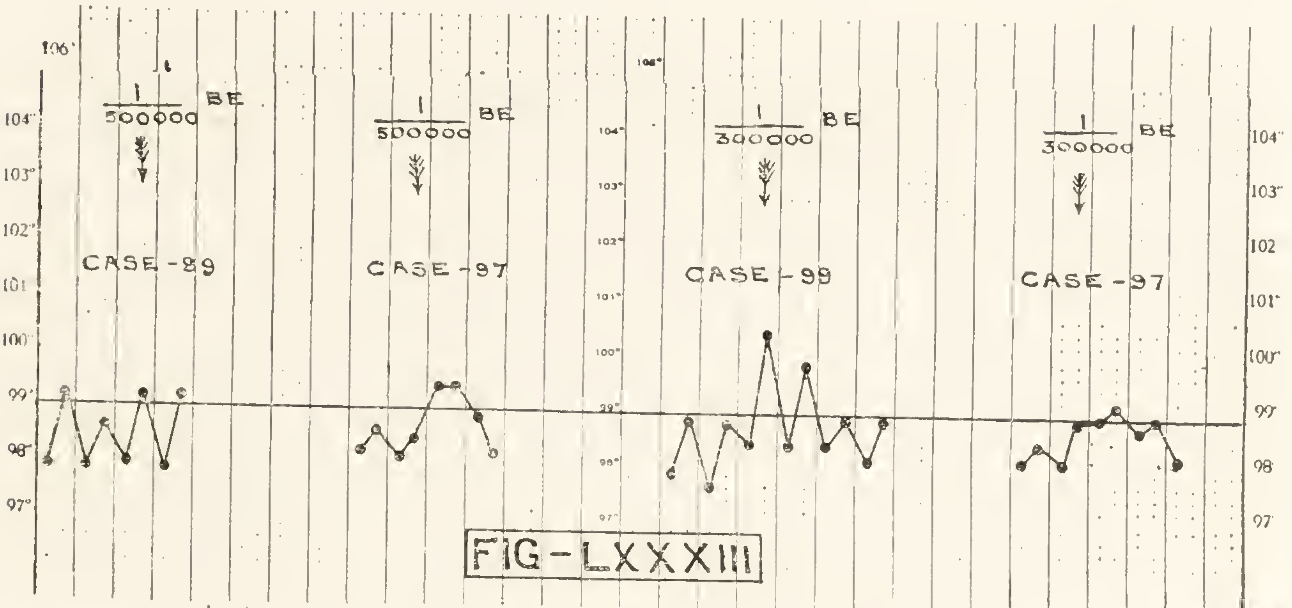

FIG - LXXXIII

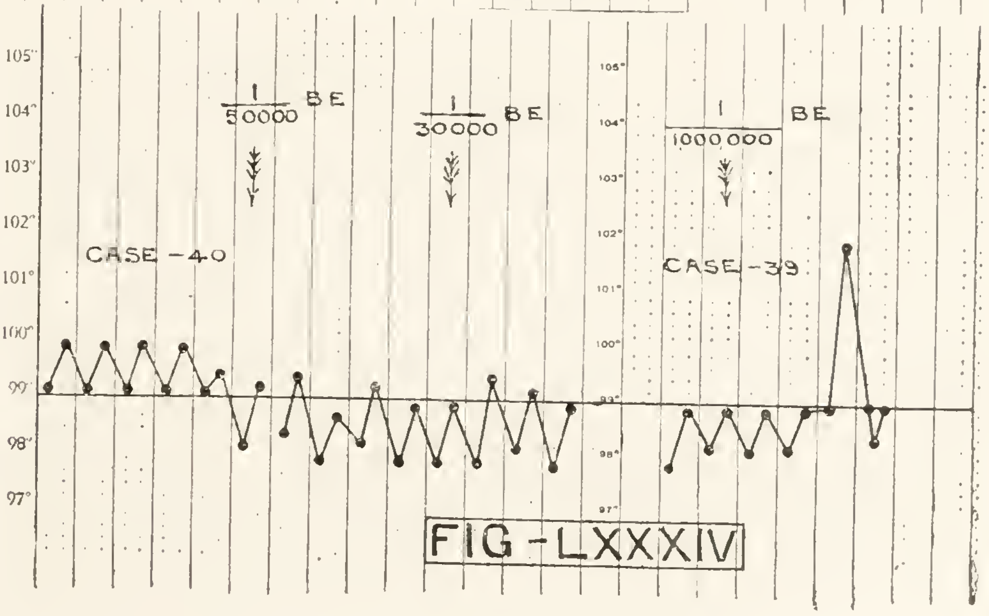

FIG - LXXXIV

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